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PIEMEISEL (R. L.). **Natural Replacement of Weed Hosts of the Beet Leafhopper as affected by Rodents.**—*Circ. U.S. Dep. Agric.* no. 739, 48 pp., 19 figs., 17 refs. Washington, D.C., 1945.

The appearance and persistence in range lands or cleared and abandoned lands in southern Idaho of weeds that serve as food-plants for the beet leafhopper, *Eutettix tenellus*, Bak., has been shown to be favoured by burning, ploughing and excessive grazing by livestock ; in the absence of these factors, the weeds were commonly replaced by annual grasses and permanent improvement resulted [*cf. R.A.E.*, A **25** 715]. This did not always take place, however, and the ecological studies here described, which were carried out in 1930–44 on three fenced plots and unfenced tracts, showed that this was due to the destruction of vegetation by rodents, chiefly hares (*Lepus* sp.).

CARRUTH (L. A.), BARTLETT (L. M.) & ADAMS (J. A.). **Japanese Beetle Abundance and Injury on Sweet Corn.**—*Bull. N.Y. agric. Exp. Sta.* no. 715, 16 pp., 3 figs., 6 refs. Geneva, N.Y., 1946.

In parts of the United States in which *Popillia japonica*, Newm., is abundant, maize is a favoured food of the adults, which are common on the fresh silks in July and August and may feed on them extensively. The leaves and stems are less severely attacked. The beetle was generally distributed throughout Nassau County, Long Island, by 1939 and increased steadily until 1943, when it was abundant, particularly in the north-central portion. After this, its numbers decreased rapidly, probably owing to drought conditions and the increased activity of introduced natural enemies, particularly *Tiphia vernalis*, Rohw., and the bacterium (*Bacillus popilliae*) causing milky disease.

Investigations on the injury caused to sweet maize, carried out during 1943–45, are summarised. In most cases there was a well-defined peak in numbers and feeding of the beetles about a week after the first appearance of the silks. This feeding appeared to have little effect on the pollination of the ears, which usually occurred within 2–3 days of the appearance of the silks [*cf. R.A.E.*, A **35** 53] ; the direct injury it caused, together with the secondary injury from birds, corn smut [*Ustilago zeae*] and other agencies that followed it, was probably more important. The beetles were less numerous in the middle of fields than at the edges, particularly when these adjoined hedgerows and grassy areas. The results of experiments in 1943 and 1944 with dusts applied to the silks to repel the beetles were inconclusive because of the small populations ; 15 per cent. phenothiazine, 0·4 and 0·75 per cent. rotenone, 15 per cent. Fermate [ferric dimethyl dithiocarbamate], hydrated lime (300-mesh), 3 per cent. DDT and 50 per cent. Ryanex gave some indications of repellent effect, but their relative efficiencies could not be accurately determined.

The factors influencing the numbers of *P. japonica* on sweet maize are discussed. At the edge of its continuous distribution, it spreads only about five miles a year by its own flight. It is scarce in the first year of occurrence in a locality, increases for several years and is then very abundant and injurious for a few years, probably owing to the lack of its principal natural enemies. After this, its numbers decline as natural enemies increase until they reach an equilibrium at a moderate level of population. *Bacillus popillae* and *Tiphia vernalis*, both of which are being colonised in New York, are among the major factors of control in the State. Summer drought is sometimes very destructive to the eggs and young larvae, and the suitability of an area for the deposition of eggs and the survival of the immature stages affects the numbers of beetles ; orchards, vineyards, meadows and cultivated fields are more lightly infested with larvae than pastures. Warm bright days and a shortage of tender foliage during the flight season favour the wide dispersal of the adults, whereas they seem to remain closer to the breeding areas and feed on

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wild plants in cool moist summers in which the foliage is succulent. Although some beetles may develop within maize fields, the heaviest damage tends to occur near large areas of turf, and injury is likely to be less severe if other attractive plants, some of which are listed, occur in sufficient numbers between the maize field and the major breeding areas. Consideration of the present state of the infestation in different counties of New York and the possibility of future injury to sweet maize indicates that although the whole of the southern two-thirds of the State is likely to become infested, it is possible that serious damage will be minimised by continued distribution of insect parasites and the spores of *Bacillus popilliae*.

PLATT (A. W.) & FARSTAD (C. W.). **The Reaction of Wheat Varieties to Wheat Stem Sawfly Attack.**—*Sci. Agric.* **26** no. 6 pp. 231–247, 3 figs., 21 refs. Ottawa, 1946.

The following is largely the authors' summary. Field trials were carried out in Alberta, Saskatchewan and Manitoba in 1940–45 to determine the reaction of wheat varieties to damage by *Cephus cinctus*, Nort. Uniform testing nurseries, in which the varieties were grown in single 10-ft. rows, replicated three times in 1941–42 and five times in subsequent years, were established at various points throughout the infested area ; all the nurseries adjoined infested wheat stubble. The most satisfactory criterion of damage was found to be the average of two independent estimates of the percentage of stems cut. By using these methods, highly significant varietal differences were established in 24 of the 28 nurseries ; the results from the remaining four were not valid and were discarded. Hollow-stemmed varieties of *Triticum vulgare* were generally susceptible, solid-stemmed varieties of *T. vulgare* and varieties of *T. durum* generally resistant. Varietal differences within each group were also established. The hollow-stemmed *vulgare* varieties suffered greatest damage under average growing conditions and least when subjected to heavy rainfall or extreme drought conditions. It is suggested that the reaction of solid-stemmed varieties is modified by rainfall, hours of sunshine and probably other factors, the exact nature of which could not be demonstrated. The resistance of *durum* varieties was high in wet years and variable in others. The use of lattice designs increased the efficiency of the tests in a number of cases. Different rates of seeding did not significantly affect varietal reactions. Single-row plots appeared satisfactory, as no evidence was obtained that any variety affected the reaction of an adjacent one. Where variable soil conditions produced uneven growth, damage by *Cephus* was also extremely variable. The advisability of establishing small, permanent areas where large populations of *Cephus* may be maintained for experimental purposes is discussed.

HORTON (J. R.), JONES (E. T.), WALKDEN (H. H.) & DEAN (G. A.). **Wheat-seeding Dates and the Hessian Fly in Kansas.**—*Tech. Bull. Kans. agric. Exp. Sta.* no. 59, 18 pp., 3 figs., 5 refs. Manhattan, Kans., 1945.

Mayetiola (*Phytophaga*) *destructor*, Say, is frequently abundant and injurious as a pest of wheat in the eastern half of Kansas, but seldom reaches threatening numbers in the western half and is often hard to find there. Since a delay in autumn sowing so that the wheat will not be up until most of the adults have emerged and died is likely to be the most efficient method of control for several years, until resistant varieties of wheat are in general use, and since sowing at the normal time results in higher yields than late sowing, investigations to find the earliest safe sowing date were carried out in various parts of Kansas in 1918–35 ; 5–7 sowings were made at intervals of five days before and after the generally accepted safe dates, and the autumn and spring infestation and yield for each were determined. The results obtained indicate that dates somewhat

earlier than those previously recommended, ranging from 25th September to 10th October according to the locality, will give practical safety and will result in little or no reduction in yields as compared with earlier dates if soil and climatic factors are favourable; sowing later than these dates will tend to reduce yields. The dates for different localities are given in a table and it is suggested that they should be observed when infestation requires it. A regular summer survey should be made to obtain information on the degree of infestation likely.

Progress Reports from Experiment Stations Season 1944–1945.—[2+] 142 pp., 4 graphs, 1 map, refs. London, Emp. Cott. Gr. Corp., 1946. Price 3*s*.

The pests of cotton occurring at various Experiment Stations during 1944–45 are discussed as in previous years [*R.A.E.*, A **34** 165]. Much of the information from Queensland (pp. 11–12) has already been noticed [**35** 243, 244]. There was little difference in oviposition by *Heliothis* [*armigera*, Hb.] on crops grown on new and old lands, but the subsequent numbers of larvae were usually greater on the more vigorous crops growing on the latter [*cf.* **34** 166]. Dusts of lead arsenate or sprays of lead arsenate and molasses, applied shortly after the recorded peak of egg-laying, reduced the numbers of larvae and increased the yield, but some larvae survived, and it is possible that better results would be obtained by applying the insecticides at short intervals after an increase in oviposition is first detected [*cf.* **31** 30].

In a report from Barberton, South Africa (pp. 14–28, 1 graph), D. MacDonald, W. L. Fielding, D. F. Ruston and H. E. King record that *Diparopsis castanea*, Hmps., attacked the early bolls of October-planted cotton, but that other insect damage was negligible. Stainers [*Dysdercus*] were numerous from early in the season, but the incidence of internal boll disease was low. Further investigations on the relation between the hairiness of a variety and its resistance to Jassid attack confirmed the conclusions previously drawn [*cf.* **34** 166]. Late-sown plants of very hairy varieties that were exposed to heavy Jassid attack were almost completely protected when once the seedling stage was passed, whereas neighbouring non-hairy plants were so heavily attacked as to be virtually destroyed. Although the highest resistance occurred when both lamina and midrib were hairy, hairiness in either conferred a definite degree of resistance.

In the first part of a report from Gatooma, Southern Rhodesia (pp. 31–38), A. H. McKinstry states that populations of Jassid nymphs were small and that the symptoms associated with Jassid damage were slight throughout the season. Larvae of the first generation of the Sudan bollworm [*Diparopsis castanea*] attacked the squares before the plants started to flower in mid-February, and probably caused almost the whole of the loss of buds and young bolls, since there was little damage by other major pests during the first few weeks of flowering. Attacks by this bollworm continued throughout the season, the larval populations remaining high until about the end of March and reaching another peak during May. Infestation by the American bollworm [*Heliothis armigera*] began to increase in the second half of March, reached a maximum about mid-April and had practically ceased by mid-May. The damage was confined mainly to the potential upper-middle and top crops, the harvested crop coming mainly from the setting of the earlier flowering, before attack by *H. armigera* became serious. The lateness of the attack on cotton was probably due to the fact that maize crops were in full tassel soon after mid-February and attracted many of the ovipositing females at that time. Spiny bollworm [*Earias*] was present in small numbers throughout the season and was particularly numerous in April. Cotton stainers were rare until the end of March, after which their numbers increased gradually until the end of May;

few were present by the end of June. Populations were composed almost entirely of *Dysdercus intermedius*, Dist., which predominated until the middle of May, and *D. fasciatus*, Sign., which was the more numerous later. The amount of staining was light on the whole. Aphids [*Aphis gossypii*, Glov.] were observed on isolated groups of plants on 13th February but the attack did not develop, probably owing to rain. They were again observed about the first week of April, and infestation increased markedly during April and early May ; leaves became covered with honeydew, and this may have caused premature senescence of the nearly mature leaves, but it is unlikely that yields were affected. Termites caused little reduction in yield.

The second part of the report (pp. 38–39) contains the results of experiments on the control of *Dysdercus*. It was found that populations of adults tended to be slightly smaller after mid-April on plants from which the tops had been removed on 26th March, though no definite trend was noticeable earlier ; that fifth-instar nymphs were less numerous on the topped plants until the end of May, after which definite differences were not discernible ; that there was no difference in the proportion of stained seed cotton (8 per cent.), whether the plants were topped or not ; and that topped plants yielded 174 lb. lint per acre, with a 36 per cent. plant stand, and the others 158 lb. with a 31 per cent. stand. Mopping with sugared solutions of sodium arsenite in water at weekly and fortnightly intervals from 27th March resulted in yields of 74 and 101 lb. lint per acre, respectively, as compared with 132 lb. for no treatment and for weekly treatment with a solution of sodium fluosilicate ; the differences were not statistically significant. The lower yields from the arsenical treatment may be due to the fact that the poison was applied in fine rather than coarse droplets [*cf.* **34** 167]. There was an average of 9 per cent. stained seed cotton on untreated plots and 2-3 per cent. less on the others, and the sodium arsenite treatment killed the greatest numbers of adults and fifth-instar nymphs, especially when applied weekly. Sodium fluosilicate killed few adults. Preliminary laboratory experiments indicated that DDT powder was toxic to *Dysdercus*, even after slight contact.

Notes on pests are included from two stations in the Anglo-Egyptian Sudan. R. L. Knight reports (p. 57) from Shambat that infestation by *Platyedra gossypiella*, Saund., was severe, but less so than in previous seasons, and that locusts caused considerable damage, including the total destruction of two propagation plots, and R. R. Anson (p. 62) from Kadugli that the flea-beetle, *Podagrica puncticollis*, Wse., did considerable damage in August and that *Sylepta derogata*, F., was observed in September, but was controlled by hand-picking.

J. D. Jameson reports from the Kawanda area of Uganda (pp. 65–71) that *Dysdercus* did great damage to the early planted crop and seriously impaired the viability of the seed. *D. superstitiosus*, F., *D. nigrofasciatus*, Stål, and *D. fasciatus* were all present and the last two were conspicuously numerous. Attempts to grow cotton free from attack by *Lygus* [*vosseleri*, Popp. (*simonyi*, auct.)] during the off-season were successful. Plots planted in November and February developed well and set a good crop by June, when they were uprooted owing to the accumulation of *Dysdercus* and bollworms. In the report from Serere (pp. 72–77), P. E. Weatherley states that *Lygus* attack began later than usual, so that cotton sown in April and May tended to escape damage until after flowering, but all cotton on the experiment farm except the very late sowings was severely attacked. Since it has been considered that the initial population of *Lygus* on cotton in that area arises by dispersal from nearby millets [*Eleusine* and sorghum [*cf.* **34** 13], no millets were grown within a quarter of a mile of the cotton on the experiment farm. This degree of segregation, however, failed to reduce the attack.

An account of agricultural conditions and their relation to cotton-growing in the Lake Province of Tanganyika Territory (pp. 78–87, 1 map) by J. E.

Peat & A. N. Prentice contains notes on the insects and diseases that attack cotton there. Jassid damage can be very severe in all districts, particularly on stunted plants in exhausted soils, though it is unimportant in some years. To the South, *Calidea dregii*, Germ., and *Dysdercus* cause serious loss in most years, *D. superstitiosus* and *D. nigrofasciatus* early in the season and *D. fasciatus* and *D. cardinalis*, Gerst., later, and the combined attack precludes the economic growing of cotton in some areas ; further north they attack the later crops and are negligible in some seasons. Mirid damage may ruin the entire crop on the richer soils in the north in wet years and probably causes a steady loss of small buds and growing points in the better areas and on the better soils in most years. It is unimportant in Shinyanga district. *Heliothis armigera* causes loss of crop in the stations and in the better grown native crops in some years, being partly associated with the planting of early maize in seasons of early rain and the cultivation of pigeon pea [*Cajanus cajan*]. *Earias* may be injurious in Shinyanga. On the poorer soils, Aphids stunt the plants in the dry spells that sometimes occur in January–March ; the plants recover later, but the crop is delayed. In a report from Ukiriguru and Lubaga (pp. 88–95), Prentice states that infestation by Jassids was low in 1944–45, but cotton on poor soils was damaged, and that attack by *Dysdercus* was light and late in the south of Sukumaland, *D. fasciatus*, the most important species, being particularly rare. *Calidea* was scarce in most areas and absent from Lubaga, but locally numerous for short periods in some northern areas. A plot at Kahama, where insects have usually caused failure of the cotton crop, was infested by various stainers, including *D. intermedius*, as well as the usual species of the Lake Province, and a species of *Helopeltis*, possibly *H. theivora*, Waterh., was also present, but infestation throughout the season was light and a good crop was obtained. *Heliothis armigera* was important in some places, but *Lygus* was not troublesome at Ukiriguru except in a moderate degree on the valley-bottom soils.

The report for the Eastern Province of Tanganyika (pp. 97–106, 3 graphs) by A. G. Bebbington & McKinstry includes records of the main insects taken throughout the season of 1944 in variety trials on various plots. Jassids (*Empoasca*) were much more abundant than usual in the early part of the season, but only a small degree of Jassid resistance appears to be necessary for cotton grown in the Eastern Province. Attack by *H. armigera* began at the beginning of flowering, reached its maximum intensity in June and July and continued for much longer than usual. Examination of shed buds showed that 60–90 per cent. of these had fallen because of bollworm damage in June. The yield from cotton planted in mid-April did not approach that from cotton planted in mid-March, although the population of *H. armigera* was much smaller on the later planting. *Platyedra gossypiella* was present in small numbers during the later part of the season, and a cotton-free period is essential to control it. *Earias* was present throughout the season on all plots, sometimes in considerable numbers, but did less damage than *H. armigera*. *Dysdercus* spp. were more numerous in most districts than in the previous season ; *D. intermedius* was the most abundant on all plots, appearing soon after the beginning of flowering and reaching a peak soon after the end of the bollworm attack, *D. fasciatus* was numerous towards the end of the season, *D. nigrofasciatus* was present throughout, and *D. cardinalis* was recorded in small numbers only. *Calidea* spp. were present on all plots, but not very important, and *Helopeltis* was numerous at Ilonga, where it caused much more surface damage to bolls than in 1943. No marked damage was caused by *Lygus*, although signs of injury were common towards the end of the season on some of the later planted cotton. In 1945, there was an increase in the acreage of cotton, but excessive rainfall retarded growth in most of the alluvial areas during April and early May, though the drier and more unsuitable areas gave better yields than for many years. Many early planted crops were seriously attacked by *Helopeltis*, and

Dysdercus caused much damage. *Heliothis armigera* was less injurious than in past seasons, but *Platyedra gossypiella* was numerous at the beginning of flowering, possibly owing to regrowth of cotton plants that had not been properly cut out.

In a report from Domira Bay, Nyasaland (pp. 109–114), H. C. Ducker & W. L. Miller state that there appears to be an eastward drift of adults of the bollworm [*Diparopsis castanea*] from ground on which cotton has been grown, possibly owing to the nightly movement of air from the Rift Valley escarpment towards Lake Nyasa. The yields obtained indicate that bollworm control under strictly summer crop conditions is fairly constant, and 10 per cent. loss of bolls may be considered inevitable. In the first part of a report on entomological work in Nyasaland (pp. 115–116), by E. O. Pearson, it is concluded from the results of experiments in 1944–45 on the possibility of obtaining an early cotton crop without reducing the yield of interplanted maize [*cf.* **34** 168] that when planted 6–12 ins. apart in rows 6 ft. apart, maize gave only 6 per cent. less grain than when planted in the normal African manner 3 ft. apart in rows 4 ft. apart, and that maize stooked three weeks earlier than usual gave slightly more grain. The second part (pp. 116–122), by Pearson & B. L. Mitchell, is a summary of a report already noticed [**34** 332] on the status and control of insect pests of cotton in the lower River Districts.

In a progress report on work on cotton in the southern provinces of Nigeria (pp. 127–130), J. West states that Ishan cotton has given yields of 300–800 lb. seed cotton per acre when grown as the sole crop, the lower figure being due to the effects of attack by *Helopeltis*, and that the yield is not affected when it is interplanted with early maize, but is reduced by 25–35 per cent. when it is interplanted with yams. *Platyedra gossypiella* was found for the first time in December 1944 [*cf.* **34** 96] and destroyed about 15 per cent. of the cotton seed. The other bollworms (*Diparopsis castanea* and *Earias*) and cotton stainers are not usually serious pests of Ishan cotton. In some years at Ibadan, *Helopeltis sanguineus*, Popp., is a major pest; during the year under review, it was successfully controlled by hand-picking.

From the West Indies, A. S. Harper records (p. 133) that the growth of cotton sown on 1st March 1945 at the cotton breeding station, Montserrat, was considerably retarded by high winds in March and April, together with an attack by *Aphis gossypii*, but that they recovered remarkably well with heavier rains in May.

[Kozhanchikov (I. V.).] **Кожанчиков (И. В.). The Problem of the vital thermal Optimum. VIII. On the Lability of Insect Development to thermal Stimuli.** [*In Russian.*]—*Zool. Zh.* **25** no. 1 pp. 27–36, 5 figs., 42 refs. Moscow, 1946. (With a Summary in English.)

The effect of temperature on the development of insects has been expressed by the equation $t(T\text{-}c)=K$ [*cf. R.A.E.*, A **23** 296], but this accounts for only certain aspects of the relation and is always inaccurate when applied to unfavourable temperatures. The temperature sum (K) varies within specific limits, increasing, like the expenditure of energy [*cf.* **22** 663; **25** 502], under unfavourable conditions [*cf.* **24** 640], and the relation can be better indicated by the accelerating effect on development of a given rise in temperature. Over a considerable part of the temperature scale, this can be represented as a straight line on a graph by plotting the percentages of total development completed in one day against temperature in degrees C. [*cf.* **31** 421]. The ratio of the change in percentage of development completed in a day to the change in temperature causing it is used by the author as an index of lability or adaptation to changes in temperature. This index differs for different species

and is shown to be 0·525 for *Hylemyia brassicae*, Bch., 0·085 for *H. floralis*, Fall., and 0·4 for *Ceratitis capitata*, Wied.

Adaptation to changes in temperature, however, must be related to the temperature sum, if the latter reflects the expenditure of energy during the process of growth, and there is reason to suppose that this expenditure of energy is related to the degree to which a species is developed morphologically. Adaptation to changes in temperature is greater in species, or stages, with a simpler, or more simplified, form of development, and these have low temperature sums. In the examples given, it is shown that the temperature sums (in day-degrees C.) for the female larvae of *Lymantria* (*Ocneria*) *dispar*, L., *Orgyia antiqua*, L., and *O. gonostigma*, F. (781, 539 and 440, respectively) are greater than those for the males (515, 440 and 394), while for the pupae, the sum is about the same in *L. dispar* for males (159) and females (148), but is less in *O. gonostigma*, in which the females have undeveloped wings, for females (88) than for the fully developed males (157) ; the corresponding sums for pupae of *O. antiqua* are 132 and 201.

It is further shown in a table that the indices of adaptation are highest and the temperature sums constantly low in the non-feeding stages of insects and in stages that naturally develop in a fluctuating temperature, for example, the eggs of *Loxostege sticticalis*, L., for which the index is 2·7 and the temperature sum 39. The indices of adaptation, temperature sums for total development and thresholds of development for 48 species of insects in six Orders are given, based largely on the literature. When the indices and temperature sums were plotted on a graph, they were found to be inversely correlated, a decrease in the temperature sum of one day-degree C. corresponding to an increase in the index of 0·0002. Thus, species that require high temperature sums, for example, soil insects such as *Cleonus* (*Bothynoderes*) *punctiventris*, Germ. (1,283), forest insects of regions with fluctuating climates such as *Malacosoma neustria*, L. (1,470), *Lymantria* (*Ocneria*) *monacha*, L. (1,240) and *L. dispar* (1,283), or tropical species such as *Nomadacris septemfasciata*, Serv. (1,145) and *Blattella* (*Phyllodromia*) *germanica*, L. (1,895), all have low indices of adaptation to temperature change (0·082, 0·068, 0·081, 0·085, 0·1 and 0·052, respectively), but there is no relation between the degree of adaptation and temperature preferences, as was seen by comparing the indices with the thresholds of development. Adaptation is connected with expenditure of energy, but not apparently with the temperature at which this takes place. Species that inhabit open country have high indices, but the highest of all are shown by parasites, such as *Trichogramma evanescens*, Westw. (0·609) and *Bracon* (*Habrobracon*) *juglandis*, Ashm. (0·59), and species that feed on plants without changing position, such as *Toxoptera graminum*, Rond. (1·04), all of which have a rapid succession of short developmental cycles.

[Zakharov (L. Z.).] **Захаров (Л. З.). The chief Laws of the Development of the Lower Volga Breeding Grounds of the Asiatic Locust.** [*In Russian.*]—*Zool. Zh.* **25** no. 1 pp. 37–40, 1 map, 9 refs. Moscow, 1946. (With a Summary in English.)

From a study of the history of *Locusta migratoria*, L., in the region of the Lower Volga from 1850 to 1940 and of its breeding areas there, the author concludes that, in the course of the last hundred years, its breeding grounds have gradually shifted from the northern part of the valley between the Volga and its tributary, the Akhtuba, first to the upper region of the delta and then to its southern part, where there are low-lying islands. This has been caused by the natural drying up of parts of the flood areas and of the delta, the

elevation of islands, the gradual replacement of swamp vegetation by the meadow-steppe type, the reclamation of flooded areas and agricultural activity, all of which rendered the earlier habitats of the locusts unsuitable and forced them into the delta where couch-grass and reeds are still abundant.

In the Caspian basin, the breeding grounds of *L. migratoria* on the Volga and the Caspian Sea and in the inundation regions of some rivers in western Kazakstan are situated in adjoining territories, which enables the locusts to migrate freely from one to another, and the east and south-east winds that prevail in summer facilitate the flight of the swarms inland. In dry years, in which there is little increase in the rivers in spring, flooding only lasts a short period and the level of the Volga is low, the locusts rapidly increase in numbers and breed over vast areas. The years of the six severe outbreaks between 1880 and 1938 were all characterised by reduced rainfall in the basin of the Volga and a low water level, and these conditions also occurred in the year preceding each outbreak [*cf. R.A.E.*, A **27** 553]. There is a reduction in years with an increased rainfall, severe floods and a high water level in the Volga, since the egg-pods are flooded and covered with mud, which kills them, and the general conditions are also unfavourable for the hoppers and adult locusts. Owing to the gradual fall in the level of the Caspian Sea and the alterations of the northern shore line, the breeding grounds between the rivers Sulak in Daghestan and Emba in western Kazakstan are gradually becoming extinct and the locusts migrate from them to the more stable grounds at the mouths of the rivers, including the Volga. It is therefore expected that they will be very active at the mouths of rivers in the next few years, provided that no sharp changes occur in the water régime of the Volga and the Caspian Sea. On the Volga, they will be most numerous in the middle and southern zones of the delta and the adjoining areas on the west and east, and egg deposits will chiefly occur in depressions among grasses and reeds. These areas should be systematically examined, and measures for the destruction of the locusts worked out.

[Zakharov (L. Z.).] **Захаров (Л. З.). Seasonal Migrations of the Asiatic Locust and their Causes.** [*In Russian.*]—*Zool. Zh.* **25** no. 1 pp. 41–44, 1 fig., 18 refs. Moscow, 1946. (With a Summary in English.)

A study of the habitats of *Locusta migratoria migratoria*, L., near rivers in the southern part of the Soviet Union, mainly those running into the Caspian Sea, showed that in the gregarious phase this locust uses grounds of two types. The eggs are laid on higher ground, and the conditions there favour the young locusts in spring owing to the abundance of food-plants, the presence of sites exposed to light and sun and the opportunities for developing the gregarious instinct. In June, however, these areas become too hot and dry, and the young locusts migrate to the low-lying flood regions where the vegetation is still fresh, shade is available and air humidity is high. Here they feed and transform into adults, and the latter remain until autumn, when it turns cold, damp and foggy and their food-plants become coarse and die off. They then migrate to the higher and drier edges of the flood regions and to the higher parts of islands and promontories where they shelter among vegetation on open sites, feed on sprouting autumn-sown crops, pair and oviposit, dying in October or November with the advent of the first frosts.

Thus, under normal conditions, the locusts change their habitats in strict sequence, the hoppers moving to sites that supply food, and the adults returning in autumn to the oviposition sites. The causes of these regular movements lie in the phenological changes that take place in the habitats and in the physiological changes in the locusts [*cf. R.A.E.*, A **21** 635].

[Fedotov (D. M.).] **Федотов (Д. М.). On functional Changes in the Imago of *Eurygaster integriceps* Put.** [*In Russian.*]—*Zool. Zh.* **25** no. 3 pp. 245–250, 4 figs. Moscow, 1946. (With a Summary in English.)

In the course of investigations on *Eurygaster integriceps*, Put., in south-western Uzbekistan and northern Kirghizia between October 1941 and September 1943, a study was made of the functioning of the internal organs of the adults throughout the year, for which purpose over 1,000 were taken in the field and dissected at various times. The results showed a high degree of adaptability to changes of season. The flight of the young bugs in June from cereals and other food-plants to the mountains where most of them aestivate and hibernate [*cf. R.A.E.*, A **32** 103 ; **33** 159] takes place at a certain stage of internal development ; if it is induced too early by unfavourable external factors, it may render them less able to survive the winter. The preparation for the flight consists in the maturation and strengthening of the various organs and tissues, the development of the fat-body and the accumulation of food reserves in the mid-gut, and in the final development of the scent glands, the secretion from which apparently facilitates the orientation of flight and the detection of accumulations of the bugs in nature. The filling of the fore section of the mid-gut with food, chiefly starch, that is preserved till the following spring, is an important adaptation, and distinguishes *E. integriceps* from other Pentatomids. The absence of microflora from the mid-gut, and its rareness in other sections of the intestine, safeguards the accumulated food from fermentation and decomposition during aestivation and hibernation. Owing to the mild climate of Central Asia, little of the reserves of food and fat is used up during the quiescent period from mid-summer till the following spring ; males hibernate with a smaller reserve than the females and use up more of it on sexual maturation during passivity, and this accounts for the higher rate of mortality among males observed both in nature and in captivity.

Hibernation is assisted by an expansion of the function of the hind-gut, which in active bugs rapidly voids the excreta and the secretions of the Malpighian tubes, but preserves them in hibernating individuals. As a result, during the rainy period, and especially in spring, the hind-gut swells enormously, and excess water within the organism is absorbed and the resistance of the bugs to cold probably thereby increased. The hibernating bugs are less resistant to dryness, and a deficiency in their internal water balance is usually fatal. The high rate of mortality that occurs in Uzbekistan in spring, connected with sharp day-and-night fluctuations in temperature and humidity in the hibernation quarters in the mountains, is probably due to disturbances in the functioning of various organs, chiefly the tracheal system, since death is accompanied by desiccation. Similar mortality in the valleys of northern Kirghizia, however, was due to low air temperatures following the melting of the snow, which caused necrosis of the tissues. The very low level of activity of the internal organs in the overwintering bugs does not apparently become established until after the autumn resumption of activity preceding hibernation ; this explains the low resistance to unfavourable conditions of young bugs taken on crops or in their aestivation quarters.

Pairing takes place soon after the resumption of activity in spring, when the bugs have practically exhausted their reserves of fat and food, and frequently before they begin feeding ; it is repeated later, when the bugs are feeding and the ovaries mature. The initial sex ratio is 1 : 1, but the females survived longer than the males and predominated throughout the whole population. Delayed sexual development in the males, as was observed in Kirghizia, is indicative of the beginning of a decline in the population of the bug. In Uzbekistan, bugs that fed on wild vegetation in spring were better nourished and possessed better developed ovaries than those that attacked the sprouting crops, but the difference had disappeared by the time of aestivation. In

northern Kirghizia, the wild vegetation is poor and almost half the bugs that fed on it before aestivation had insufficient fat and a very small reserve of food in the mid-gut.

[Ostrovskiĭ (N. I.).] Ostrovsky (N. I.). **Fecundity in Females of *Stenodiplosis panici* Rodd. as influenced by Feeding Conditions at larval Stage.**—*C. R. Acad. Sci. URSS* (N.S.) **52** no. 6 pp. 555–556. Moscow, 1946.

Severe damage to millet in the Soviet Union is sometimes caused by *Stenodiplosis panici*, Plotnikov [*cf. R.A.E.*, A **25** 272], and investigations on the fecundity of the females of this Cecidomyiid were carried out in the laboratory at Voronezh. They emerge with mature eggs and under favourable conditions begin to oviposit immediately after fertilisation, but the numbers of eggs in individuals dissected on the day they left the millet panicle were found to vary from 40 to 120. Experiments were, therefore, carried out to determine whether conditions prevailing in the egg or larval stage were responsible for this variation.

For this purpose, infested plants of two kinds of millet, *Panicum miliaceum* and *Echinochloa* (*Panicum*) *crusgalli*, in pots were used, some being normally watered while others were not, so that their leaf-tips wilted. Before the adults emerged, the panicles containing larvae were transferred to test-tubes; the females were dissected on the day of emergence, and the panicles were later examined for the presence of any diapausing or dead larvae. The results are given in two tables and showed that the total numbers of larvae per floret ranged up to 7–9 in plants of *P. miliaceum* that were watered and up to 5 in those that were not, the most usual numbers being 2–4 and 1–3 respectively. The corresponding maxima for *E. crusgalli* were 4 and 3, respectively, and the commonest numbers 1–2 in both groups. The numbers of eggs developed per female averaged 102·7 and 96·8 when there was only one larva per floret in watered and non-watered *P. miliaceum* respectively, and these averages fell to 43·5 and 40·5 as the numbers of larvae increased to their maxima. On *E. crusgalli*, the averages fell from 93·6 to 26 for watered plants and from 69·7 to 30 for the others. It is concluded that the fecundity of the females varies inversely with the number of larvae per floret, and that this varies with the food-plant and the conditions of moisture under which it is grown.

[Bolduirev (V. F.).] **Болдырев (В. Ф.). Orthopterous Insects injurious under Greenhouse Conditions and their Control.** [*In Russian.*]—*Dokl. sel'sk. Akad. Timiryazeva* no. 3 pp. 88–91. Moscow, 1946.

Two Orthoptera that are injurious to vegetables in greenhouses in the Soviet Union are the Gryllacrid, *Tachycines asynamorus*, Adel., which has been recorded from many parts of European Russia and from Sukhum in Transcaucasia, and the Gryllid, *Gryllulus domesticus*, L., which occurs in and near Moscow. Observations on the food-preference of caged examples of *T. asynamorus* and examination of the stomach contents of individuals taken in greenhouses showed that they were polyphagous and fed on slow-moving, dead or dying Arthropods as well as on the living or dead parts of plants. They could not perforate the more compact and elastic tissues of fruits, tubers, bulbs or leathery leaves, but injured germinating seeds, cotyledons, the first leaves, tender stems and sometimes ripe sweet fruits, especially if the skin was broken [*cf. R.A.E.*, A **15** 227; **27** 652]. They remained motionless in shady places during the day, and fed, paired and oviposited at night, the eggs being laid in the soil of the beds, pots or boxes. In air-dry soil, the eggs remained viable for over two months and could thus survive the transport of plants from one greenhouse to another. The females laid up to 400 eggs in a month, and one laid over 600 in four months. The optimum conditions for development and activity were a temperature of 20–25°C. [68–77°F.] and a relative humidity of

70–80 per cent. combined with the presence of water for drinking ; under these conditions, the egg and nymphal stages lasted 2½ and 3 months and the adults became sexually mature in 10–15 days. The females, which lived for 6–7 months, continued to lay eggs throughout life. Activity became abnormal at 30–33°C. [86–91·4°F.], torpor set in at 36–39°C. [96·8–102·2°F.] and 6°C. [42·8°F.] and death supervened at 40–41°C. [104–105·8°F.] or −6°C. [21·2°F.]. In experiments on control by means of poisoned baits, the best results were given by sodium fluosilicate or sodium fluoride mixed with moistened wheat bran or finely crumbled rye bread. The bait should be exposed in shallow bowls or on pieces of wood, and kept moist. Dusting the insects sheltering in the shady parts of greenhouses with pyrethrum was also effective.

G. domesticus was repeatedly observed injuring seedling cucumbers, lettuces, spinach, tomatos and egg plant [*Solanum melongena*] and was found breeding in the field in large heaps of stored manure and in an accumulation of litter and droppings from a pigsty, in which it could probably overwinter owing to the warmth of the manure. Observations on the effect of temperature on the crickets showed that they were very active at 20–22°C. [68–71·6°F.], but 28–30°C. [82·4–86°F.] was the optimum ; they were restless at 35–37°C. [95–98·6°F.], became torpid at 41–43°C. [105·8–109·4°F.], and died at 47–48°C. [116·6–118·4°F.]. They were not affected by temperatures between −1 and −3°C. [30·2 and 26·6°F.], but all died at −6 or −7°C. [21·2–19·4°F.]. In tests of poisoned baits, the best results were given by wheat bran mixed with sodium fluoride, sodium fluosilicate or sodium arsenite. Reducing the temperature in greenhouses to from −8 to −10°C. [17·6–14°F.] would destroy both the Gryllacrid and the Gryllid.

[Savzdarg (É. É.).] **Савздарг (Э. Э.). The Biology of *Lixus subtilis* and its Control.** [*In Russian.*]—*Dokl. sel'sk. Akad. Timiryazeva* no. 3 pp. 91–94. Moscow, 1946.

Of the many species of insects that attacked sugar-beet when its cultivation was begun on a large scale in Uzbekistan, the first to appear in early spring was *Lixus subtilis*, Sturm. Observations in 1942–43 in the Province of Samarkand showed that the weevils migrated to beet from *Amarantus* spp., and the severity of the infestation, which ranged from 40 to 100 per cent. of the plants, was in direct proportion to the prevalence of weeds in adjoining plots at the time or in the beet field in the preceding year. The damage is caused chiefly by the larvae, which burrow the leaf stalks and flower stems, but the adults gnaw small pits in the leaf-stalks and the mid-veins during the periods of supplementary feeding and oviposition, causing the formation of gall-like swellings [*cf. R.A.E.*, A **16** 667]. The numbers of eggs laid per leaf averaged about three for the more developed outer leaves and less than two for the young inner ones, and the percentages of leaves infested were 81 and 2, respectively. Infestation was thus higher in plots containing stronger and larger plants, but these also yielded the best crops, and in some instances the heavily infested plots of beet sown early (in March) produced better crops than less infested plots sown late (in April). There were two overlapping generations a year, of which the first was active from May to the beginning of September and the second from July to the beginning of November, when the young adults entered hibernation. The seasonal occurrence of the different stages is shown in a table, from which it appears that adults are present throughout the year, eggs in May and June and again from July to the beginning of September, larvae from May to the end of October, and pupae in June and July and again from September to the beginning of November.

The increase of the weevil was considerably checked by competition between the larvae, since even when there were as many as 9–13 larvae in the same leaf

stalk only one or occasionally two reached maturity. Up to 25 per cent. of the larvae of the first generation and up to 85 per cent. of the second were killed by an undetermined Ichneumonid ectoparasite.

Poisoned baits were not sufficiently effective for control, and the best results were obtained by dusting the beet with sodium fluosilicate during the period of supplementary feeding of the adults, which reduced the percentage of injured leaves by half and the number of the eggs laid per leaf by one-third. Nevertheless, control should consist chiefly in preventive measures, such as the destruction of weeds, early sowing of beet, manuring, irrigation, the removal of crop remains that may harbour larvae or pupae, and autumn ploughing to destroy the hibernating weevils.

Stapel (C.) & Bovien (P.). **Mark-Frøafgrødernes Sygdomme og Skadedyr.** [The Diseases and Pests of Field Crops grown for Seed.]—9 × 6 ins., 227 [+5] pp., 48 col. pls. Copenhagen, Kgl. danske Landhusholdningsselskab [1943]. Price *Kr.* 5.50.

Gram (E.) & Bovien (P.). **Rodfrugternes Sygdomme og Skadedyr.** [The Diseases and Pests of Root Crops.]—2nd edn., 9 × 6 ins., 125 pp., 48 col. pls., 8 figs. Copenhagen, Kgl. danske Landhusholdningsselskab, 1944.

These two books relate to the conditions of Denmark and are arranged on similar lines ; some of the information included is common to both. The first has chapters dealing with clovers, lucerne, peas, broad beans, lupin, grasses, carrot, beet and crucifers grown for seed, and the second on beet, swedes and turnips, and carrots. Under each crop there is a section on pests, almost all of which are insects, and others on diseases, including those caused by viruses that are transmitted by insects, if any. The notes on the individual pests are brief and mostly deal with the type of damage caused, the life-history of the pest and the appearance of the injurious stages. Recommendations for control are made in some cases, and both books have final sections containing notes on the preparation and use of various common insecticides and fungicides.

Gösswald (K.). **Einwirkung des Puppensammelns bei den verschiedenen Waldameisenarten.** [The Effect on the various Kinds of Forest Ants of collecting the Pupae.]—*Z. angew. Ent.* **30** pt. 3 pp. 317–335, 6 figs., 20 refs. Berlin, 1944.

Serious damage has been caused to colonies of the red forest ant (*Formica rufa*, L.) in Germany by the collection of its pupae for commercial purposes, and 70 per cent. of those known to the author have been destroyed in this way, including some that had only just been established. He here discusses the harmful effects of disturbing the nests of this ant, which is one of the most useful predacious forest insects [*cf. R.A.E.*, A **27** 231], and suggests that any pupae genuinely required should be obtained from artificial colonies specially established for the purpose.

Gasow (H.). **Analysen von Mageninhalten einheimischer Vögel als Stichproben.** [Analyses of random Samples of the Stomach Contents of indigenous Birds.]—*Z. angew. Ent.* **30** pt. 3 pp. 336–363, 3 figs., 21 refs. Berlin, 1944.

The results are given of analyses of the stomach contents of 120 birds belonging to ten different families, chiefly Corvids and *Sturnus vulgaris*, taken in different types of country, mostly in Westphalia, between 1925 and 1942.

The majority contained insect remains, and details of the species recovered so far as they could be identified, are included.

SCHWERDTFEGER (F.). **Weitere Beobachtungen zur Lebensweise der Kiefernschonungsgespinstblattwespe,** *Acantholyda erythrocephala* **L.** [Further Observations on the Mode of Life of *A. erythrocephala*.]—*Z. angew. Ent.* **30** pt. 3 pp. 364–371, 4 refs. Berlin, 1944.

The outbreak of *Acantholyda erythrocephala*, L., on pine near Schwerin on the Warthe spread considerably in 1940 and 1941 [*cf. R.A.E.*, A **35** 212] and involved a large area of forest at the confluence of the Warthe and Netze, where these rivers run nearly parallel. Increasingly large areas of infested State and private forest were dusted from the air in the years 1941–43, and at the end of these operations the population of the sawfly had been reduced to its normal level.

Observations on its bionomics were continued at various places during these years, and the results are compared with those obtained in 1940 [*loc. cit.*]. The adults were in general first observed on 15th May, 9th May and 22nd April in 1941, 1942 and 1943, respectively, were present for 22, 26 and 23 days, and were most numerous in the periods 20th–25th May, 20th–28th May and 27th April to 8th May. Eggs were first observed on 20th May, 25th May and 26th April. The main feeding periods of the larvae were 9th–20th June, 14th–24th June and 1st–10th June, and descent to the ground began on 2nd July, 2nd July and 20th June and was completed in 19, 17 and 14 days. The lateness of adult emergence in 1941 as compared with 1940 is attributed to the temperature in April, which averaged about 2·3°C. [4·14°F.] lower. The adults were most active in the warmest part of the day, and little or no flight was observed during cool, wet and windy weather. Eggs were laid in warm, sunny and sheltered positions, chiefly in the middle region of the crown, except after unfavourable weather, when they were most abundant in the lower region ; oviposition was particularly heavy on trees with light, sparse foliage, and heavier on *Pinus banksiana* than on neighbouring *P. sylvestris*. In 1943, the eggs were laid mostly in batches of 2 or 3, whereas in 1940, when the adult population was high, they were mostly laid singly.

Egg mortality was very low in 1940 and 1941, but *Trichogramma evanescens*, Westw., parasitised 10–20 per cent. of the eggs in 1942. In 1943, 67 per cent. of the eggs died in one district, probably due to an unusually severe frost that occurred in May, 80 per cent. were parasitised by *Trichogramma* in another, and it is estimated that only 5–15 per cent. of the eggs laid in that year hatched. Some young larvae were also killed by the late frost, and of 198 half-grown examples taken from their webs, 12 per cent. were dead. In the winter of 1940–41, 5 per cent. of 600 larvae taken from the soil were parasitised by *Xenoschesis fulvipes*, Grav., and cocoons of this Ichneumonid probably represented a further 5 per cent. of the original *Acantholyda* population. The percentages of larvae parasitised in the two following winters were 1–11 and 1–4, respectively. An Ichneumonid identified as *Eulimneria* sp., possibly *E. crassifemur*, Thoms., was abundant during the feeding period of the larvae and may have parasitised some of them.

In a test begun in June 1940 on the time taken to complete the life-cycle, about 50 full-fed larvae were allowed to enter a patch of uninfested soil ; 9 males and 13 females emerged in May 1941, and two more females in May 1942, but no further adults emerged in the following spring. In another test, counts of larvae in the soil were made in a forest area from which the trees were cleared early in May 1940 to prevent any from entering subsequently. In addition to the larvae collected in 1940–41 [*cf.* **35** 213], some were still present on 8th April 1942, when 76 per cent. of them were in the pronymphal stage ; none was found

on 6th October. It is concluded from these two tests that the life-cycle of *A. erythrocephala* lasts 1–3 years, or possibly even longer. There was no indication of mortality among the diapausing larvae in the second test.

BRAMMANIS (L.). **Pflanzenpathologie im Ostland. 5. Mitteilung. Der Hausbock** (*Hylotrupes bajulus*) **in Lettland.** [Plant Pathology in the Baltic States. Fifth Communication. *H. bajulus* in Latvia.]—*Z. angew. Ent.* **30** pt. 3 pp. 372–380, 2 figs., 5 refs. Berlin, 1944.

In Latvia, where most buildings are constructed of wood, severe damage is caused to them by *Hylotrupes bajulus*, L., particularly on the coast from the southern border to the Gulf of Riga, where scarcely a dwelling is uninfested along a strip of territory 12–18 miles deep and extending in places more than 30 miles inland. The abundance of the Cerambycid in this area is attributed to the mild maritime climate, since it is rare in other parts of the country. Observations have shown that dwellings and stables are more frequently infested than sheds and granaries, probably owing to the higher temperatures in them. Infestation occurs chiefly in the walls and near windows, especially on the south side of buildings, and seldom or never in the roof which is usually covered with shingles, although roof timbers are attacked in masonry houses in the towns. Even the thin material used for doors, ceilings, floor-boards and window-sills is heavily attacked in heated rooms, and poles bearing telegraph wires or electric cables are infested when in proximity to dwellings. The wood of both pine and spruce is attacked, but whereas the latter may be completely eroded, the heartwood of pine is not infested. The literature on the incidence of the pest in other countries is reviewed, and the control measures employed are briefly discussed. Since toxic chemicals are too dangerous to apply in dwellings, precautionary measures should be adopted at the time the buildings are constructed; these include the use of uninfested seasoned wood and treatment with preservatives. Buildings should be suitably ventilated and not constructed of round logs, unless these are plastered or otherwise covered within two years.

ZIRNITIS (J.). **Pflanzenpathologie im Ostland. 6. Mitteilung. Die Blattlausfauna der Kartoffel in Lettland.** [Plant Pathology in the Baltic States. Sixth Communication. The Aphid Fauna of Potatoes in Latvia.]—*Z. angew. Ent.* **30** pt. 3 pp. 381–390. Berlin, 1944.

Records are given of seven species of Aphids found on potato in Latvia during surveys from 1924 to 1942, with notes on their distinguishing characters and on other plants attacked by them. They cause little direct injury to potato, which is not the main food-plant of any of them, and the only one considered of importance as a vector of virus diseases of potato is *Myzus* (*Myzodes*) *persicae*, Sulz. In Latvia this species survives and reproduces during the winter in greenhouses and in warm rooms in dwellings if there are suitable food-plants in them, but cannot overwinter in the open, and the general adoption of control measures in such places should reduce the spread of potato viruses to a minimum.

BECKER (G.). **Der natürliche Schutz des Laubholzes gegen Hausbockkäferlarven und seine Ursache.** [The Natural Resistance of Wood of deciduous Trees to Larvae of *Hylotrupes bajulus*, L., and its Cause.]—*Z. angew. Ent.* **30** pt. 3 pp. 391–417, 4 figs., 15 refs. Berlin, 1944.

An account is given of numerous laboratory tests, designed to ascertain why larvae of *Hylotrupes bajulus*, L., which are very injurious to the timber of conifers in Germany, are unable to develop in that of deciduous trees [*cf. R.A.E.*,

A **33** 19]. The results showed that deciduous wood was not rendered suitable by the action of wood-destroying fungi, by the removal of various constituents by extraction with ether, alcohol or cold or hot water, by treatment with dilute sulphuric acid or by the addition of proteins or carbohydrates, with or without extraction, and impregnation with extracts from deciduous wood had little effect on the nutritive value of coniferous sapwood. The larvae survived, however, in deciduous wood that had been soaked for 48 or 24 hours, respectively, at room temperature in 1 or 5 per cent. sodium hydroxide and then for 17 days in distilled water, and increased somewhat in weight, and there was some evidence that this was connected with the removal of pentosans.

Blunck (H.). **Zur Kenntnis der Hyperparasiten von** *Pieris brassicae* **L. 1. Beitrag.** *Mesochorus pectoralis* **Ratz. und seine Bedeutung für den Massenwechsel des Kohlweisslings.** [Contributions to the Knowledge of the Hyperparasites of *P. brassicae*. First Contribution. *M. pectoralis* and its Importance in the Control of *P. brassicae*.]—*Z. angew. Ent.* **30** pt. 3 pp. 418–491, 11 figs., 5 pp. refs. Berlin, 1944.

A detailed account is given of investigations carried out in western Germany on the bionomics and importance of the Ichneumonid, *Mesochorus pectoralis*, Ratz., which is an internal parasite of the larvae of the Braconid, *Apanteles glomeratus*, L., the most important larval parasite of *Pieris brassicae*, L. ; it was found in the course of the work that *M. stigmaticus*, Brischke, which has been recorded from *Orgyia antiqua*, L., is a synonym of *M. pectoralis*. Lists are given of the hosts of *Mesochorus* spp. recorded in the literature, from which the author concludes that almost all of them attack other Hymenoptera, whether the latter are free-living or themselves parasites ; *M. pectoralis* has been recorded from ten Braconids, two Ichneumonids and 29 Lepidoptera. The technique of rearing *M. pectoralis*, the morphological characters of the adults of both sexes, and a method of preserving them as specimens in 78 per cent. alcohol are described. In the laboratory, the adults, which were obtained from cocoons of *A. glomeratus* originating from *P. brassicae*, were active and required large amounts of water and oxygen ; both sexes fed on sugar and water, but in nature they probably fed on nectar. There were considerable differences in the time for which individuals survived, but it is thought that males and females probably live for 1–2 weeks and one month, respectively, in the field ; males of *A. glomeratus* lived for only a few days in the laboratory, and females for 1–2 weeks. The adults are sexually mature 2–3 days after emergence ; the females produce up to 100 eggs in nature, whereas females of *A. glomeratus* produce more than 500.

In breeding experiments, newly hatched larvae of *P. brassicae* were exposed in cages to newly emerged adults of *A. glomeratus*, and a batch of 10–20 eggs was laid in each of them within half an hour ; larvae in which more than 100 eggs were laid did not survive long and the parasites died. Parasitised larvae in various instars were placed in cages with individual females or pairs of *M. pectoralis* but only the younger larvae, chiefly those in the second instar, were hyperparasitised. Of 40 larvae that were subsequently dissected, 38 contained from 6 to 120 or more eggs or larvae of *A. glomeratus*, but only six that had been exposed in the early instars contained *M. pectoralis*. When the larvae were reared, the results were similar, adults of *Mesochorus* emerging from only two that had been exposed to hyperparasitism in the second instar, seven males in one case and twelve in the other. *M. pectoralis* was also bred from batches of parasitised larvae of *P. brassicae* collected in the fourth and fifth instars at various places in the Rhineland, but not from younger individuals or from larvae that were not parasitised by *Apanteles*. In this field-collected material, *Mesochorus* was accompanied by the Eulophid, *Tetrastichus rapo*, Wlk., which is also known to be a hyperparasite developing in *A. glomeratus*, and by

one or other of two Tachinids identified as *Zenillia* (*Phryxe*) *vulgaris*, Fall., and *Compsilura concinnata*, Mg. These were primary parasites of the larvae of *P. brassicae*; they fed on the internal organs and developed in a single host together with *A. glomeratus*, which fed on the body fluid. *Zenillia* was the commoner, and when the host contained only one example of it in addition to *A. glomeratus*, both parasites reached maturity, but if more than one Tachinid was present, the Braconid larvae died and only the Tachinids emerged. It is thought that the simultaneous presence of the Tachinids would not prevent the development of *Mesochorus* or *Tetrastichus* in *Apanteles*, but this could not be confirmed. The percentage parasitism of *Apanteles* by *Mesochorus* was usually low, but amounted to 50 in one instance.

The eggs of *M. pectoralis*, which are described, are deposited singly in the *Apanteles* larvae and hatch within a week. The larvae doubled their original weight in five days; development was subsequently retarded, but became rapid again after the *Apanteles* larvae had emerged from their hosts and spun cocoons, which they did at the same time as unparasitised individuals. Complete development in both *Apanteles* and *Mesochorus* lasted about 3–4 weeks in summer and 6–7 weeks in spring; both species overwinter in their cocoons, and, like *P. brassicae* in Germany, have two generations a year. In the laboratory, adults of the autumn generation of both emerged throughout the winter, even in the absence of heating, but in the field they did so only from April to early June.

The author has studied the factors that limit the natural increase of *P. brassicae* in Germany over 12 years and discusses the results in some detail. It is almost impossible to forecast outbreaks on cultivated crucifers because of the irregular distribution of the latter and the migratory habits of the butterflies. The increase of the population is limited by unfavourable weather and to a considerable extent by natural enemies. The eggs are destroyed by small birds and by *Forficula auricularia*, L., which also attacks young larvae; the only egg parasite observed was *Trichogramma evanescens*, Westw., which, together with the predators, sometimes causes almost complete mortality in the Rhineland and other favourable districts. The larvae are attacked by virus and bacterial diseases and by the fungus, *Entomophthora sphaerosperma*, which, in damp regions, sometimes causes complete mortality in a few days and therefore constitutes one of the most important regulating factors. Pupae are also killed by it and various diseases; the most important parasite of the pupae is *Pteromalus puparum*, L., which is practically never attacked by hyperparasites. The effect of parasitism of the larvae by *A. glomeratus* is great and the author has observed whole populations of both generations destroyed by it over considerable areas, but the average percentage parasitism is estimated to be about 60. Hyperparasites do not affect control of the current generation of *P. brassicae*, but reduce the number of parasites available to attack the next generation; they are themselves parasitised to some extent.

The author has reared many thousands of Hymenopterous hyperparasites attacking *A. glomeratus* in *Pieris brassicae* from material collected in Germany, Lower Austria, Lithuania or western Poland. They comprised in all some four dozen species of Ichneumonids and nearly three dozen Chalcidoids. Records are given in tables of those that emerged from batches of *Apanteles* cocoons from which *M. pectoralis* was also obtained, together with a list of upwards of 40 of them that have been generically or specifically identified. They include *Habrocytus blunckii*, sp. n., and a species tentatively identified as *H. eucerus*, Ratz., both of which were found in Germany and Poland and are described in an appendix. By far the most numerous were *Dibrachys cavus*, Wlk. (*boucheanus*, Ratz.), *Hemiteles nanus*, Grav. (*fulvipes*, Grav.), *Tetrastichus rapo*, *Habrocytus poecilopus* Crwf., *Hemiteles submarginatus*, Bridgm., *Leptocryptus brevis*, Thoms., and *H. areator*, Panz., in that order; *M. pectoralis* was comparatively infrequent.

It is estimated that hyperparasites destroy in all about 80 per cent. of the population of *A. glomeratus*, and that *M. pectoralis* has no practical effect on its numbers or consequently on those of *P. brassicae*.

CAMBOURNAC (F. J. C.) & PITTA SIMÕES (J. M.). **Observações sôbre a eficácia de vários métodos de combate às larvas dos géneros *Anopheles* e *Chironomus*, nos viveiros dos arrozais.** [Observations on the Efficacy of various Methods of controlling the Larvae of *Anopheles* and *Chironomus* in Rice Seed-beds.]—*An. Inst. Med. trop.* **1** fasc. 2 pp. 315–325, 7 refs. Lisbon, 1944.

Larvae of the genus *Chironomus* and of a mosquito (*Anopheles maculipennis*, Mg.) develop in the rice-fields at Aguas de Moura, Portugal. The former make galleries in the soil preparatory to pupating, and in so doing cut off and destroy the young rice plants [*cf. R.A.E.*, A **32** 180]. Several hundred larvae were repeatedly observed in sections of soil four inches square and less than an inch deep. Hardly any oviposition takes place during the summer, but overwintering eggs are laid in autumn ; the adults die during the winter. Chemical control is impracticable in the fields, owing to their size, but tests were carried out with various chemicals in the seed-beds in an attempt to secure control of both insects. The results are shown in tables ; the plots were examined daily during the investigations, but *Chironomus* was generally too numerous for exact counts to be made. Calcium cyanamide and Paris green both proved ineffective against *Chironomus*, whether used as suspensions in water or mixed with road dust, and copper sulphate and chloride of lime (containing 10 or 20 per cent. free chlorine) were effective only at concentrations that injured the plants. The best results were obtained with creolin, which gave a practically complete kill of *Chironomus* larvae at final dilutions of 1 : 20,000 and 1 : 30,000 and also controlled the mosquito larvae. It was diluted with water and applied from a watering-can and caused no plant injury. A mixture of 10 pints creolin, 8 pints petrol, 1 pint turpentine and 20 oz. naphthalene gave similar results. Complete mortality of both insects was also obtained by draining the rice plots for five days, and the growth of the plants was not impaired.

EBELING (W.). **Problemas relacionados con las pestes que afectan a los citrus y otras plantas subtropicales en Chile.** [Problems connected with the Pests of *Citrus* and other subtropical Plants in Chile.]—*Agricultura téc.* **5** no. 2 pp. 197–212. Santiago, Chile, 1945.

This is a translation of a report of observations made by the author during a tour of inspection of the principal fruit-growing districts of Chile in May 1945. The geographical distribution of the plantations is reviewed, and the cultural methods employed are criticised at some length. Particular attention is given to *Citrus*, of which the cultivation has increased greatly during recent years. The most important pest of this crop is *Lepidosaphes beckii*, Newm., which is present throughout the country ; *Aonidiella aurantii*, Mask., also occurs, but is at present restricted to the region of Quillota. Some lemon trees near Vallenar were infested by *Chrysomphalus dictyospermi*, Morg., which was also abundant on leaves and fruits of orange in the Huasco valley. Other insects that occasionally damage *Citrus* are Aphids, thrips, *Pantomorus godmani*, Crotch, *Icerya purchasi*, Mask., *Hemiberlesia* (*Aspidiotus*) *rapax*, Comst., and *Pseudococcus* spp., particularly *P. citri*, Risso. *Saissetia oleae*, Bern., is of little importance on this crop. The principal control methods available against Coccids are fumigation with hydrocyanic acid gas and spraying with oil emulsions ; the author recommends fumigation to control the severe infestation of *A. aurantii* in Quillota. Directions are given for applying oil sprays and for determining the quantity of oil deposited on the trees [*R.A.E.*, A **29** 410] ; a medium light mineral oil, having an unsulphonatable residue of not less than 92 per cent., should be used

on orange, and a medium or medium heavy oil on lemons. These methods are not effective against *Pseudococcus* spp. or *Icerya purchasi*, but *Coccophagus gurneyi*, Comp., has been successfully introduced against *I. purchasi* and *P. gahani*, Green [*cf.* **35** 8], and *Rodolia cardinalis*, Muls., against *I. purchasi* [**31** 290]. Various Hymenopterous parasites were introduced in 1933 against *S. oleae* [**31** 290], and it was planned to introduce *Metaphycus helvolus*, Comp. [but *cf.* **35** 21].

Olive was attacked by *S. oleae*, and, in the Huasco valley, by *Chrysomphalus dictyospermi*, which was particularly numerous, together with a small mite, around the peduncles of the fruit. Their presence caused a slight dent and discoloration in the fruit. *H. rapax* was occasionally found on olive, and severe infestations by *Pinnaspis* (*Hemichionaspis*) *minor*, Mask., were observed on olive, cotton and willow in the Azapa valley. This Coccid had probably spread to Chile from Peru ; it cannot be controlled with oil sprays at the normal concentrations, and the treatment recommended is brushing the main branches, which are the parts principally attacked, with a 5–10 per cent. kerosene emulsion. Avocados are attacked by thrips and sometimes by *Aspidiotus hederae*, Vall., and a heavy infestation by *C. dictyospermi* was observed at a place to the east of Vallenar. Chirimoya [*Annona cherimolia*] is occasionally attacked by *Pseudococcus citri*, and was heavily infested in La Serena by *P. gahani* and *P. adonidum*, L. (*longispinus*, Targ.). The only important pest of figs is *Graphidothrips stuardoi*, Moulton, which attacks both fruits and foliage. In view of the low price obtained for the fruit, control is not economically justified, and the damaged fruit is used to make coffee substitute.

Olalquiaga Fauré (G.). **Nuevas identificaciones y notas adicionales de insectos y arácnidos de Chile.** [New Identifications and additional Notes on Insects and Arachnids in Chile.]—*Agricultura téc.* **5** no. 2 pp. 213–219, 28 refs. Santiago, Chile, 1945.

Brief records are given of various insects and mites found recently in Chile. Those that have not previously been reported from that country include the weevil, *Pantomorus* (*Atrichonotus*) *taeniatulus*, Berg, which was taken on *Capsicum frutescens* in the Province of Los Andes. Pests new to the districts in which they were taken include the Bostrychid, *Neoterius mystax*, Blanch., which was found attacking roof timbers of quila wood (*Chusquea* sp.) in a chalet in Colchagua. The timber had been brought from the south about two years before. Considerable damage was done by *Dichroplus maculipennis*, Blanch. [*cf. R.A.E.*, A **35** 19] to lucerne in Polpaico in the summer of 1944–45; the plants had been eaten to the ground over an area of about 250 acres in early January. No immature stages of the grasshopper were found, and no females with fully developed eggs. Young leaves and shoots of grape vines in Ovalle were damaged in December 1944 by a Eumolpid identified as *Dictyneis pulvinosa*, Blanch.

Among insects new to the plants on which they were found were the Bostrychids, *Dexicrates robusta*, Blanch., and *Micrapate* (*Bostrychulus*) *scabrata*, Erichson, both boring in avocado trees. The former was known as a pest of several other fruit trees, and the latter as a borer in dry wood, but it was found even in the non-lignified shoots of avocado and grape vine. A bug identified as *Nabis punctipennis*, Blanch., was collected on *Capsicum frutescens* in the course of investigations into possible vectors of a virus that affects that plant. This bug is known as a predator on Aphids on carnation, and is not thought to be phytophagous. *Dermestes peruvianus*, Lap., which had previously been recorded in dried meat from Los Andes, was found infesting skins intended for sausages in a warehouse in Santiago.

Parasites reared included *Metaphycus* (*Aphycus*) *flavus*, How., and *Coccophagus caridei*, Brèth. (*heteropneusticus*, Comp.) from *Saissetia oleae*, Bern., on

Lucuma obovata, and a species of *Apanteles* identified as *A. paphi*, Schrottky, by Muesebeck, who considers that this may be a synonym of *A. congregatus*, Say, from larvae of *Protoparce* sp. on tomato near Santiago.

Olalquiaga Fauré (G.). **Insectos de los envases del té procedente de Ceylan y el problema de su exclusión.** [Insects in the Containers of Tea from Ceylon and the Problem of their Exclusion.]—*Agricultura téc.* **5** no. 2 pp. 219–221, 4 refs. Santiago, Chile, 1945.

In February 1945, 7–8 per cent. of a number of plywood chests containing tea from Ceylon were found on arrival at Valparaiso, Chile, to be infested by boring beetles. Some of the holes were 1–1·5 mm. in diameter, others 4–5 mm., and long galleries extended in the central layer of the three-ply wood. The species found comprised the Bostrychids, *Dinoderus minutus*, F., and *Heterobostrychus aequalis*, Waterh., the Lyctid, *Minthea rugicollis*, Wlk., and an unidentified species that belonged to some other family. Examination of the tea contained in the infested chests yielded one adult Cerambycid too badly damaged for identification. Living larvae, pupae and adults of *D. minutus* and *H. aequalis* were found, including gravid females; brief notes are given on the morphology and bionomics of the two species and of *M. rugicollis*. All three species were thought to be new to Chile, and a careful check was kept on subsequent shipments of tea to prevent their becoming established. Cases showing signs of attack were burned, and the others were emptied and fumigated with carbon bisulphide. The current fumigation methods were used, but the results were not considered entirely satisfactory. Hydrocyanic acid gas was not used for fear of tainting the tea, but in tests in which tea was treated with carbon bisulphide, professional tea-tasters could distinguish no alteration in its flavour.

Olalquiaga Fauré (G.). **La " chinche de la alcachofa " en Quillota.** [*Lygus fraudulentus* in Quillota.]—*Agricultura téc.* **5** no. 2 pp. 221–223, 7 refs. Santiago, Chile, 1945.

A Mirid considered by growers to be responsible for a reduction in size of the heads of artichoke [*Cynara*] in the Quillota Valley, Chile, and for the discoloration and withering of the leaves, was identified as *Lygus fraudulentus*, Stål, which also infests artichoke in La Plata, Argentina. It was present in great numbers in the axils of the leaves, near the ground and away from the light. From observations over two successive winters the author concludes that it hibernates in the adult stage. No eggs were observed on plants examined in the laboratory during spring and summer. Bordeaux mixture at the current fungicidal strength was ineffective as a repellent, and little control was afforded by sprays containing soap or nicotine sulphate and soap or a dust of sulphur and pyrethrum. The Lygaeid, *Geocoris sobrinus*, Blanch., was also observed on artichokes in the same region, but its importance was not known.

Rosenberg M. (G.). **El efecto de algunos insecticidas en el establecimiento y desarrollo de las larvas migratorias de la conchuela roja de los citrus *Aonidiella aurantii* (Mask.).** [The Effect of some Insecticides on the Establishment and Development of Crawlers of the Citrus Red Scale, *A. aurantii*.]—*Bol. Dep. Sanid. veg.* **3** no. 2 pp. 143–165, 1 fig., 2 graphs, 4 refs. Santiago, Chile, 1944.

A detailed account is given of experiments carried out in California in 1943–44 on the effect of the incorporation of DDT in oil sprays on the establishment and subsequent development of crawlers of *Aonidiella aurantii*, Mask., on *Citrus*. The results were similar to those already noticed [*R.A.E.*, A **33** 113, etc.] and showed that when lemon fruits sprayed in the field in autumn were

artificially infested with crawlers in the laboratory, by a technique that is described, on various subsequent dates, a spray containing 1·75 per cent. medium light miscible oil was unsatisfactory, but that when DDT was added to the oil before emulsification at the rate of 6 gm. per 100 cc., establishment was prevented for about 26 days and development for over 50 days. A spray of 3 per cent. kerosene was useless by itself, and though it still did not prevent establishment when DDT was added to the kerosene at 8 gm. per 100 cc., it effectively prevented development for 56 days.

FRIEND (R. B.). **Connecticut State Entomologist, Forty-fourth Report, 1944.**— *Bull. Conn. agric. Exp. Sta.* no. 488, pp. 301–425, 17 figs., refs. New Haven, Conn., 1945.

R. B. Friend (pp. 301–308) gives a brief survey of insect pests and records of their abundance in Connecticut during the year ending 31st October 1944, M. P. Zappe (pp. 308–311) summarises the results of the annual inspection of nurseries for pests and diseases and Zappe and L. A. DeVaux (pp. 311–313) review the results of inspections for the presence of *Popillia japonica*, Newm., and the gipsy moth [*Lymantria dispar*, L.]. In a survey of the work on the control of *L. dispar*, D. LaBelle and Friend (pp. 319–321) state that defoliation increased during the year, though not to a serious extent [*cf. R.A.E.*, A **34** 233]. Temperatures in the winter of 1943–44 were not low enough to affect the eggs to any extent, and the percentage hatch was 86·7 [*cf.* **34** 234]. A stand of hemlock [*Tsuga*], in which many of the trees were 90–100 ft. high and which had been injured by larvae of *Lambdina athasaria pellucidaria*, G. & R., in previous years, was sprayed with lead arsenate and fish oil on 22nd–23rd June, since a flight of this Geometrid had been observed on 31st May and 1st June. No defoliation was noted when the trees were inspected later in the season.

Zappe (pp. 322–323) reports that scouting for elm trees infected with Dutch elm disease [*Ceratostomella ulmi*] showed that the disease was spreading to the east and increasing where it was already known to be present. A new technique, in which samples of bark, bark-beetles and the galleries made by them are taken from dead or dying trees and large broken branches, enabled its presence to be ascertained before visible symptoms appeared. Trap logs were again of no value in determining areas infested by *Scolytus multistriatus*, Marsh. [*cf.* **34** 236], but provided some evidence of the presence of *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh. ; a small felled elm that was left leaning against other trees at a distance of two feet from the trap logs was attacked by *Scolytus*. This beetle is now known to be established in 25 towns east of the Connecticut River.

P. Garman (p. 330) states that as a result of using the potato tuber moth [*Gnorimoschema tuberculella*, Zell.] as a host for *Macrocentrus* [*ancylivorus*, Rohw.] in the laboratory, the number of the latter reared during the year was considerably increased and 65,000 were liberated [against *Cydia molesta*, Busck] in peach orchards. Further consignments of parasites [*Pseudaphycus* sp.] for the control of the mealybug [*Pseudococcus comstocki*, Kuw.] in apple orchards were received from Virginia [**34** 234], and collections in various localities indicated that the parasite was established and was reducing infestation in some of them. Populations of *Popillia japonica*, Newm., were found to be decreasing in south-western Connecticut, but increases occurred in some parts of the State.

Work on the biological control and natural mortality of *P. japonica* is described by J. C. Schread (pp. 331–339). In 1934, the average percentages of larvae infected with *Bacillus popilliae*, which causes milky disease, were 38·3, 29·9 and 25·8 in experimental plots established in 1939, 1940 and 1941, respectively, 30·9 in all these plots together (as compared with 24·08 in 1943) and 31·74 in control plots 33–880 yards from them. The numbers of larvae

per sq. ft. in the experimental plots averaged 2·4 in 1943 and 2·3 in 1944. Diseased larvae were found in a town in which no spore distributions had been made, and the percentages infected varied from 5·2 to 18·5. In studies over a period of two years on the rate at which the disease spreads from a single inoculation point, diseased larvae were found 14–18 ft. from the point at which the inoculation was made on one occasion in each year; the average larval population was 9·7 per sq. ft. in 1943 and 5 in 1944. Spore dust applied to lawns at rates of 8, 12 or 16 oz. per 1,000 sq. ft. on 21st September 1943 gave good results from late May 1944, but the higher rates were no more effective than the lowest. Rates of 4–8 oz. are therefore recommended, especially if a severe infestation is to be controlled within a year; a rate of 2 oz. gives similar results in several years. Applying the dust in autumn minimises injury by the larvae since most of them will become infected at the height of the feeding period. Soil temperatures to a depth of 3 ins. were high enough for the development of *B. popilliae* in the larvae after 4th–6th May, but diseased larvae were not present in any quantity until June or early July. The spread of the disease was most rapid where the larvae were most numerous and where soil inoculations were made close together. Owing to the dry season, adult emergence was delayed, and peak abundance was not reached until two weeks later than usual; delayed development of the third instar and a preponderance of second-instar larvae entering hibernation is also attributed to this cause. Cocoons of *Tiphia vernalis*, Rohw., were present in 1944 in 21 of 55 of the sites at which this parasite had been liberated. The time that had elapsed since the parasites were liberated did not appear to influence the number of *Popillia* larvae present, but the proportion of parasite cocoons was considerably greater in sites colonised in 1936 and 1938 than in those colonised in 1942. Collections of adults showed that *T. vernalis* had survived in large numbers in several localities in three towns. Males were abundant in mid-May, but no females were observed until 31st May. *T. popilliavora*, Rohw., is well established at widely-distributed localities, but, owing to the dry season, very few adults were observed in 1944; emergence was delayed, and many apparently did not leave the soil. Eggs of the Tachinid, *Centeter cinerea*, Aldr., were found on adults of *P. japonica* at one locality [*cf.* **28** 643]. Mortality among larvae of *Popillia* during the winter of 1943–44, when temperatures were not very low, but there was little snow, varied from 2·5 to 43 per cent. It averaged 16·7 per cent., as compared with 6·6 per cent. in 1942–43, when there were fewer days without snow cover, and only 1·2 per cent. in 1944–45, when snow was present for three months and temperatures in the upper 6 ins. of soil were above the point lethal to the larvae (15°F.) except for 60 hours in early February.

Garman (pp. 339–341) states that control of the plum curculio [*Conotrachelus nenuphar*, Hbst.] in apple orchards varies greatly from year to year, and he presents data collected in 1938–44 to study the relation between damage by this weevil and high spring temperatures. Damage was severe only in 1939, 1940 and 1943, and these were the only years in which mean temperatures exceeding 70°F. occurred within a week after petal-fall, though maximum temperatures of 75° or more occurred in this period in 1941 and 1944. In two of the four years of light infestation of apple, including 1944, when damage to plum and peach was heavy, temperatures reached 75°F. on two successive days before the apple trees flowered; this is thought to have caused the overwintered adults to emerge earlier than usual and to seek alternative food-plants.

Garman and J. F. Townsend (pp. 341–344) state that *Hoplocampa testudinea*, Klug, was injurious to apple in Connecticut for the first time in 1944, when a coastal strip about ten miles deep was infested. At least seven varieties of apple were attacked, and damage was most severe on early ones. The distribution, bionomics and control of this sawfly are reviewed, and its future status in Connecticut discussed. Limited observations indicated that serious infestations did not develop on well-sprayed trees near heavily infested ones,

and attack was heaviest in orchards in which one or more early sprays were omitted.

D. E. Greenwood (pp. 344–347) gives an account of work on *Limonius agonus*, Say, which at times causes serious damage to potatoes and tobacco on sandy soil. The larvae feed heavily in early spring on newly-set potato tubers and then do not feed for 8–10 weeks, though they may be numerous near the tubers. From mid-July they feed at random over a period of many weeks ; the percentage of injured tubers did not always increase from August to October, but the number of holes per tuber increased from 1–2 to 6–12. Injury to potatoes grown for five successive years on plots that had previously been under green manure crops [*cf.* **34** 235] increased from 10–15 per cent. in 1940 to about 75 per cent. in 1944 ; this increase is not attributed solely to increased populations. In view of the satisfactory control obtained by sowing bait crops to attract the larvae, so that they can be destroyed by means of a fumigant before the main crops are sown, field tests were made to determine how early sufficient larvae assemble at the baits to render the method justifiable. They congregated at maize as early as the first week in May, but even this is late enough to delay potato planting to some extent. Maize and wheat sown on heavily infested soil in late September, after potatoes were harvested, did not attract the larvae in autumn. Pieces of potato tuber with the eyes removed set beside tomato and peppers [*Capsicum*] at planting time have given good protection. In laboratory tests, sprays containing 2 or 4 gm. DDT in 100 cc. deodorised kerosene were effective against the adults, and a dust containing 3 per cent. DDT applied to the surface of the soil in pots, or worked into the top inch, at rates equivalent to 50 and 100 lb. per acre killed all the beetles that were caged over the soil. DDT was not toxic to the larvae. Tests with earthworms indicated that though the contact action of DDT on them is soon overcome, there is considerable stomach action, all those in soil containing DDT at a rate equivalent to 100 lb. per acre behaving normally for 14–16 days but dying within a month.

N. Turner (pp. 348–353) describes tests with DDT dusts against pests of vegetables. When applied on 26th May and 3rd June to newly set tomato plants against the potato flea-beetle [*Epitrix cucumeris*, Harr.], they reduced damage (estimated by amount of feeding) from 83·3 to 18·3 per cent. at DDT concentrations of both 2 and 4 per cent. and to 21·7 per cent. at concentrations of both 1 and 0·5 per cent., whereas 36·7, 35, 38·3 and 25 per cent. damage occurred on plants dusted with 50, 25, 12·5, and 6·25 per cent. cryolite in pyrophyllite. All the DDT dusts caused chlorosis of the young leaves, and although the plants outgrew the injury, it was still noticeable on 25th June. Potatoes were dusted on 26th May and 2nd June, when *E. cucumeris* was moderately abundant, and again on 8th and 14th June with DDT and cryolite at the above concentrations and with derris dust containing 0·25, 0·5, 1 and 2 per cent. rotenone. Examination on 5th June showed that DDT at 0·5 and 1 per cent. was as effective against *E. cucumeris* as 50 per cent. cryolite and 2 per cent. rotenone, respectively. Both protection and yields increased with the concentration of DDT. The plants were examined on 12th July for larvae of the corn borer [*Pyrausta nubilalis*, Hb.]. The reductions in numbers of larvae were erratic and amounted to 61–79·9 per cent. for DDT, 29–69·8 per cent. for derris, and 47·9–62·1 per cent. for cryolite. Late sweet maize was dusted with the DDT and derris dusts and with dusts containing 1, 2, 4 or 8 per cent. fixed nicotine against *P. nubilalis* on 2nd, 7th, 12th and 17th August. DDT reduced the numbers of larvae in the plants during the last ten days of August by 40·4–69·9 per cent., derris by 12·3–57·9 per cent., and nicotine by 19·9–52·4 per cent. In tests in which the DDT dusts or Bordeaux mixture were applied to potato on 6th, 18th and 25th July and 1st, 15th and 22nd August against the potato leafhopper [*Empoasca fabae*, Harr.], the DDT dusts and the strongest and most effective Bordeaux mixture (4 : 2 : 50) reduced the

numbers of nymphs on 2nd August by 60·5–84·2 and 31·6 per cent. and the percentage of tipburn on 13th August from 90·5 to 59·1–83·6 and 73·8, respectively ; dosage response curves indicated that 2 per cent. DDT should be about equal to the spray for prevention of tipburn.

Turner (pp. 353–356) also describes studies of the value against insect pests of Dithane (disodium ethylene bis-dithiocarbamate), a water-soluble fungicide that is absorbed by plants from the soil [*cf.* **35** 121]. When plants were grown from bean seeds treated with Dithane, Fermate (ferric dimethyl dithiocarbamate) or Spergon (chloranil) at rates of 0·125, 0·25, 0·5 and 1 per cent. by weight, 1 per cent. Dithane, 0·25 and 0·5 per cent. Spergon and 0·5 per cent. Fermate gave reductions in infestation by larvae of the Mexican bean beetle [*Epilachna varivestis*, Muls.] as compared with no treatment, but the greatest reduction was only 35 per cent. When solutions containing ½–4 lb. Dithane per 100 U.S. gals. were applied in trenches to growing beans at the rate of 1 U.S. gal. per 10 ft. of row on 13th June, 4 lb. Dithane reduced the population of larvae of *E. varivestis* on 13th July in each replicate, as compared with no treatment, and 2 lb. reduced the total number in all replicates. The same concentrations of Dithane were applied to potatoes by watering them at the rate of 1 U.S. pint per plant on 26th May and 1st and 14th June and compared with sprays of Bordeaux mixture (16 : 8 : 100, 8 : 4 : 100, 4 : 2 : 100 and 2 : 1 : 100) and dusts of cryolite (50, 25, 12·5 and 6·25 per cent.) ; the damage due to *Epitrix cucumeris* and *P. nubilalis* and the percentages of dead leaves were estimated on 5th June, 12th July and 11th June, respectively. The dusts gave the best control of *Pyrausta*, against which the sprays were not effective, and both reduced damage by *Epitrix*. Dithane did not substantially reduce feeding by overwintered adults of *Epitrix*, but adults feeding in July appeared to cause considerably less injury in the plots treated with it than in the controls. It substantially reduced damage by *Pyrausta* at all concentrations except the highest, and plants treated with it had fewer dead leaves than those treated with the other materials or the controls. The yield increased as the concentration of Dithane increased, and only plants that received the lowest concentration yielded more than the controls ; the total yield for Dithane was higher than for Bordeaux mixture but lower than for cryolite. A solution of 4 lb. Dithane per 100 U.S. gals. applied to early sweet maize at the rate of 2½ U.S. gals. per 10 plants on 13th June, about one week after the eggs of *P. nubilalis* had begun to hatch, gave negligible control of the larvae and was much less effective than a 4 per cent. fixed nicotine dust. Late potatoes were treated against *Empoasca fabae* on 29th June, 17th July and 1st August with the Dithane solution at the rate of 1 U.S. pint per plant. The numbers of nymphs per 40 leaves on treated and (in brackets) control plants were 20 (35) on 18th July, 19 (25) on 25th July and 20 (28) on 2nd August, and the percentages of tipburn on 4th August were 33 (50), but the yield was 5 per cent. lower on treated plants.

Turner (pp. 357–358) also gives data showing the adverse effect of alkaline diluents on cryolite dusts. A dust of 50 per cent. cryolite in fibrous talc (pH 9·1) was less toxic to *Epitrix cucumeris* on early tomatos than one of 12·5 per cent. cryolite in pyrophyllite (pH 7), and cryolite in the talc was less toxic to second-generation larvae of *Epilachna varivestis* on beans than in pyrophyllite at three of four concentrations tested.

P. P. Wallace (pp. 358–373) gives an account of investigations in which the leaves were removed from elms to study the effect on the structural development and growth of deciduous trees of defoliation such as that caused by insects. The following is taken from his summary. The treatments comprised one or two complete defoliations in early June and mid-July. Terminal die-back, one of the most noticeable effects of defoliation, was most extensive on trees defoliated twice ; after treatment in two successive years the trees appeared in fairly good condition and only one died. A single defoliation caused a slight

increase in the mean length of the twigs, but two caused a great decrease. The total twig length was much the greatest on the controls and became successively less as defoliation increased. One defoliation decreased the number of living twigs, but two resulted in a substantial increase. The mean total weight of twigs on control trees was three times that on trees defoliated once, and greater still than on trees defoliated twice. The diameter increment during the year following one or two treatments was about one-quarter that of the controls, and the number of leaves produced per tree was significantly less after one defoliation and about the same after two ; the mean size of the leaves and the mean area of leaf surface per tree were progressively reduced, however. The date of foliation in spring was not affected by the site of the tree or its vigour, but it was delayed by one defoliation in the preceding year and to a greater extent by two. Buds on shoots formed after defoliation were small, and this is important in the development of subsequent growth from them. Defoliation did not render the trees susceptible to attack by bark-beetles, but defoliated elms were more susceptible to *Ceratostomella ulmi* than the controls. Seedlings two-years old showed no significant response to defoliation, but variation in shoot growth and total weight increment within the groups of small plants was more pronounced than in older trees, indicating marked hereditary influences while the plants are young.

Wallace (pp. 373–395), on whose summary the following is largely based, describes all stages and observations in Connecticut on the bionomics and control of *Aegeria* (*Synanthedon*) *scitula*, Harr., which bores in the ornamental *Cornus florida* [*cf.* **23** 461]. The adults emerge from late May to the end of September, mostly in the first half of July, and the eggs are laid on the bark of trunk or branches. The larvae become established only if they encounter a broken bark wound or cracked callous area of such a nature that immediate protection is available. There is one generation a year, though larvae in all stages of development are usually present at any time. They hibernate within the bark, but remain completely inactive only as long as air temperatures are near freezing point. Pupation occurs in the larval gallery, close to the bark surface. Two parasites, *Ephialtes* (*Ichneumon*) *irritator*, F., and a species of *Amblyteles* related to *A. vitalis*, Cress., were reared during the study, and an unidentified Clerid was commonly found in the galleries and was observed feeding on the larvae. In tests in which various materials were painted over injured surfaces to prevent infestation, the most satisfactory results were given by shellac and asphalt paint ; they were equally effective, but asphalt paint was removed by the carpenter ant, *Camponotus herculaneus pennsylvanicus*, Deg. A DDT spray applied to the trunk gave inconclusive results, since no infestation developed in the controls, but was effective in preliminary tests against *Aegeria* (*Sanninoidea*) *exitiosa*, Say, the habits of which are similar to those of *A. scitula*, when applied on budded nursery peach trees at a concentration of 1½ lb. DDT per 100 U.S. gals., with a deposit builder, in late June, before the adults emerged.

J. P. Johnson (pp. 407–411) records further observations on *Aphonus castaneus*, Melsh., infesting turf [*cf.* **32** 96 ; **34** 237]. Larvae were found in the upper inch of soil in September–October 1942; later in October, just before the soil was frozen, most were within 4 ins. of the surface. In 1943, 50 per cent. were within 2 ins. of the surface on 1st April and 96 per cent. within 5 ins. Pupae were first collected in the field on 6th July, pupae and adults were both present on 29th July, and only adults could be found in the soil on 17th August. In the laboratory, the pupal stage lasted 13–16 days. Adults were not seen above the soil, though they were still present in it in autumn. A few adults were found in the soil in the spring of 1944 and on the surface or in flight in June. No feeding was observed, and no eggs were found nor were any laid in the laboratory. A mummifying muscardine fungus tentatively determined as *Isaria militaris* was fairly prevalent in the autumn of 1942 and had become

abundant by 1943. It attacked both larvae and pupae and was probably responsible for the scarcity of adults in 1944. Unidentified parasites that pupated in September were reared from larvae in the laboratory in 1943.

An account of infestation by *Dermestes ater*, Deg. (*cadaverinus*, F.) in a large block of flats in New Haven in the winter of 1944–45 is also given by Johnson (pp. 411–415), together with descriptions of all stages and recommendations for control. The peak flight occurred in the first fortnight of December, with occasional large flights subsequently. Flights persisted in two incinerator rooms, which were considered to be the source of the infestation, and many pupal cases were found on the basement floor and in the débris on the floor of a wood storage room. Large flights continued in January in one part of the building, and the incinerator serving it was found to be heavily infested. Mice were abundant, and the beetles might breed on dead ones. Intermittent flights occurred in an apartment above one of the incinerator rooms from late November until January, the adults appearing in the evening, when temperatures were high. Both adults and larvae emerged from crevices in base-boards, etc., and holes and crevices were observed in the basement ceiling. Adults have been recorded only from buildings in Connecticut, but they have been observed in every month of the year, and breeding may therefore be continuous. They survived in the laboratory for 3–4 weeks, and the few eggs deposited hatched in 5–6 days. The beetles are probably attracted by the odour from the burning waste material or unburnt refuse, and the thorough removal of ashes and unburnt material at least once a fortnight is recommended.

Schread (pp. 416–418) reports that *Alsophila pometaria*, Harr., has increased in abundance in Connecticut in recent years and caused extensive damage in several parts of the State in the spring of 1944. As egg-masses were abundant on shade trees, collections were made in two counties from December 1943 to April 1944 to determine the degree of parasitism. In all, 51,001 eggs were collected, and the average percentage hatch in the laboratory was 71·2; the parasites reared were 20 females and 10 males of *Telenomus alsophilae*, Vier., and four females and one male of *Trichogramma pretiosum*, Riley. Parasitism evidently took place in December, despite the cold weather at that time of year, but it is pointed out that *Trichogramma* can develop in 30 days at 47–49°F., that most of the host eggs were probably laid on the southern side of the trees and that the temperature of bark exposed to the sun would be rather higher than that of the atmosphere.

In a section dealing with miscellaneous insects (pp. 418–421), Johnson reports that a spray containing 6 lb. lead arsenate, ½ U.S. gal. white oil (viscosity 80 seconds Saybolt), 1 lb. bentonite and ¼ lb. Ultra-wet per 100 U.S. gals. water [*cf.* **34** 234], applied to the greater part of a small vineyard on 13th July 1944 when adults of *Popillia japonica* were beginning to emerge in numbers and attack the foliage, proved highly effective. Shoots that developed after the treatment were defoliated to some extent, but enough leaves were protected for a good yield to be produced. The unsprayed vines were severely defoliated, and the fruit produced by them was unmarketable. R. L. Beard records the finding of a few Tachinid larvae parasitising larvae of *P. japonica*; pupae were also observed, and one of them yielded an adult that was identified as probably a species of *Macrometopa* or a closely allied genus. Johnson reports that turf in two towns was severely damaged in the latter part of May and early June by larvae of *Crambus laqueatellus*, Clem., and *C. trisectus*, Wlk., which were numerous, and *C. mutabilis*, Clem. Adults were abundant during the summer and were also taken at two other towns. G. H. Plumb states that *Acantholyda erythrocephala*, L., which was collected in Connecticut for the first time in 1942, has since been found in several places in the southern part of the State. In one, infestation was fairly heavy and many trees were defoliated. *Pinus strobus* was the only observed food-plant. Zappe reports the occurrence in early May of large numbers of clover mites [*Bryobia praetiosa*, Koch] in houses, which

they entered through windows and doors on the south side. Sprays and dusts of DDT were of little value against them, but they were controlled by applying sulphur dust to the ground and south side of the buildings.

TATE (H. D.) & BARE (O. S.). **Corn Rootworms.**—*Bull. Neb. agric. Exp. Sta.* no. 381, 12 pp., 7 figs., 7 refs. Lincoln, Neb., 1946.

Diabrotica virgifera, Lec., *D. longicornis*, Say, and *D. duodecimpunctata*, F., commonly occur in Nebraska, where the first two are major pests of maize and have become more important in recent years owing to more favourable rainfall, increased irrigation and the spread of *D. virgifera* into areas in which maize is grown commercially. *D. virgifera* was first observed in Nebraska in 1929 and 1930, when some injury occurred in about five south-western counties, but was of little importance during the severe drought that followed. Since 1941, however, it has become more injurious and has spread across the State almost to Grand Island. It occurs in destructive numbers in the south-western, central and south central parts of the State and is particularly important in irrigated fields in the Platte River Valley. *D. longicornis* was first reported as abundant in Nebraska in 1889 and has been destructive in the eastern third of the State since 1891. Although it occurs throughout the State, it is not important in other parts.

The eggs of both species are laid in maize fields in late July, August and September, usually close to maize stalks and ½–1½ ins. below the soil surface, and overwinter. The larvae hatch in June and move through the soil to find maize roots; they devour the smaller roots and tunnel in the larger ones and crowns, and this is often followed by decay. Severely damaged plants make little growth and often fall over. The reduction in yield of infested plants depends on the stage of growth, moisture conditions, soil fertility and the vigour of the variety, since the plants may replace the root system and produce a good yield if these factors are favourable. So far as is known, the larvae of both species attack only maize, no evidence of injury to sorghum and other crops in fields in which maize was injured in the previous year having been found. They pupate in cells in the soil during July. The adults emerge in late July and August and most of them have died before the first heavy frost. They feed on the silks and pollen of maize, sometimes preventing complete pollination, and on a number of other plants that flower in summer and early autumn, and those of *D. virgifera* also on the leaves of maize.

Since the eggs are laid in maize fields and the larvae die of starvation if they do not find maize roots, complete control can be obtained by avoiding the planting of maize for more than one year on the same ground. Experience has confirmed this despite occasional unsubstantiated reports of damage to maize the first year after clover, rape and a few other crops, possibly explained by oviposition of adults attracted to the pollen of these plants when the supply decreases in the maturing maize fields. Field observations have shown that maize can usually be grown in the same fields for two years in succession with little or no injury by *D. longicornis* and in a third year without serious injury, and it appears that it may be grown for three or possibly four years in succession without serious damage by *D. virgifera* except in the irrigated region of the Platte River Valley, where heavy populations have developed and growing maize a second year may be unprofitable. Other practices that tend to reduce loss are ploughing before planting, destroying self-sown maize, irrigating when the plants are about knee-high and as often as necessary until at least the middle of August, and growing varieties that show most resistance to attack.

D. duodecimpunctata occurs throughout Nebraska in summer, but seldom becomes of much importance on maize except in the south-eastern quarter of the State and in counties of central and south-western Nebraska along the Kansas border. Unlike the other two species, it hibernates in the adult stage

and cannot survive the winter in Nebraska; infestations there are due to a northward migration of overwintered adults beginning about the end of May and reaching a maximum about 25th June. They deposit eggs round young maize plants and the larvae tunnel in the roots and crowns, causing lodging. Plants of many kinds other than maize are also infested. First-generation adults begin to emerge in late July and become most abundant during the first half of August. There appears to be one complete generation and only a partial second, if any, in Nebraska. Control is difficult, but ploughing early in spring, and keeping down weed growth until planting time and clean cultivation are likely to make the fields less attractive to the ovipositing beetles. Maize planted early or moderately early seems to suffer less damage than later plantings.

GRANDFIELD (C. O.) & THROCKMORTON (R. I.). **Alfalfa in Kansas.**—*Bull. Kans. agric. Exp. Sta.* no. 328, 64 pp., 1 col. pl., 27 figs., 23 refs. Manhattan, Kans., 1945.

This bulletin contains a section (pp. 56–60, 3 figs.) by R. L. Parker & D. A. Wilbur on insects associated with lucerne in Kansas. It includes brief notes on the habits and control of some of those that are injurious; these comprise grasshoppers, of which at least four species are involved [*cf. R.A.E.*, A **25** 680], blister beetles [Meloids], of which the larvae feed on grasshopper egg-pods and the adults are often injurious during grasshopper outbreaks, several species of cutworms and armyworms of which the army cutworm [*Chorizagrotis auxiliaris*, Grote] is injurious in early spring, the variegated cutworm [*Peridroma saucia*, Hb.] chiefly during June and the fall armyworm [*Laphygma frugiperda*, S. & A.] during September and October, the corn earworm [*Heliothis armigera*, Hb.], the garden and beet webworms [*Loxostege similalis*, Gn., and *L. sticticalis*, L.], the pea aphis [*Macrosiphum onobrychis*, Boy.], and the clover seed Chalcid [*Bruchophagus gibbus*, Boh.].

The most important insects that trip the flowers of lucerne are solitary bees of the genera *Megachile* and *Nomia* (*Paranomia*); the former are fairly common in Kansas and the latter may occur on the high plains. Bumble bees (*Bombus* spp.) are fairly effective pollinators, but are relatively few in numbers, and honey bees do considerable tripping if sufficiently numerous [*cf.* **35** 174]. The average seed production of one bushel per acre can be increased to 2–4 bushels by the encouragement of greater populations of the pollinating insects; placing colonies of honey bees by lucerne fields at the rate of 2–3 strong colonies per acre materially helps pollination and seed setting.

AHLGREN (G. H.). **Planting and Caring for the Lawn.**—*Bull. N. J. agric. Exp. Sta.* no. 724, 32 pp., illus., 7 refs. New Brunswick, N.J., 1946.

A section of this bulletin deals with pests attacking lawns in New Jersey (pp. 23–26, 3 figs). Larvae of the Japanese beetle [*Popillia japonica*, Newm.] and similar beetles often cause severe injury to the turf. The eggs are laid 1–3 ins. deep in the soil during the summer, and the larvae feed in the upper few inches of soil, consuming the grass roots; when ten or more per sq. ft. of soil surface are found, severe damage is likely. The most practical method of control is the application of lead arsenate powder at the rate of 10–15 lb. per 1,000 sq. ft., preferably in spring or early autumn, which normally protects the turf for 5–10 years. Diluting the arsenical with 40–50 lb. of good topsoil helps to ensure uniform application. Sod webworms [*Crambus*] sometimes do serious damage on limited areas in dry seasons, especially on green and luxuriant lawns. Spraying with 2 lb. lead arsenate in 20 U.S. gals. water or dusting with 8–10 lb. lead arsenate, per 1,000 sq. ft., has given effective control [*cf. R.A.E.*, A **29** 408]. The dust should be brushed and then watered in very

lightly ; it is not effective if applied with topsoil. A pyrethrum spray gives more rapid control, but is expensive and unsuitable for large areas. The chinch bug [*Blissus leucopterus*, Say], which feeds near the base of the leaf, is a serious pest on lawns, particularly during dry, hot years. Dusts containing nicotine or rotenone [*cf.* **30** 552] have not always proved effective against it, but recent experiments have shown that the application of 100–200 lb. per acre (2½–5 lb. per 1,000 sq. ft.) of a dust containing 10 per cent. sabadilla or DDT gives almost complete control ; the higher rate is required in hand-dusting. Applications should be made during the hot part of the day and timed to destroy the young nymphs, which usually appear in May or early June and again in August. Ants do little damage to permanent turf grasses, but the mounds they form are objectionable. They may be controlled by pouring carbon bisulphide or calcium-cyanide powder into openings made in the nest and round it to a depth of about six inches and covering the openings with soil or a damp cloth. Pouring boiling water into the ant hills is effective if repeated several times.

WOLFENBARGER (D. O.). **Cuban Laurel Thrips Control on** *Ficus benjamini*.—*Florida Ent.* **28** no. 4 pp. 82–83. Gainesville, Fla., 1946.

A severe infestation of *Gynaikothrips uzeli*, Zimm., developed on *Ficus benjamina* at a sub-tropical experiment station in Florida, the tree concerned having been severely injured by a hurricane in 1945. The thrips feed on the upper surface of the leaves, which fold over them and protect eggs, young and adults. In an experiment on control, sprays of nicotine sulphate, DDT (as an emulsified solution), DDT with Lethane 60 [an aliphatic thiocyanate], and benzene hexachloride were applied to different branches of the tree, the percentages of active ingredient being 0·1 for benzene hexachloride, 0·125 for nicotine sulphate and DDT, and 0·25 for Lethane 60. Counts made 2, 5, 7, 10 and 14 days after treatment showed that the total numbers of thrips present per 10 leaves were 534 for nicotine sulphate, 29 for DDT, 9 for DDT with Lethane 60, and 1 for benzene hexachloride, as compared with 920 for no treatment. DDT and Lethane 60 decreased the number to 5 after two days, whereas DDT alone decreased it to 26. None of the treatments appeared to cause foliage injury. New leaves had developed and become infested 12–14 days after spraying, but thorough treatment of neighbouring trees with DDT indicated that reinfestation would be less rapid if all infested leaves were treated.

Modification of Regulations of European Corn Borer Quarantine No. 41, second Revision.—*B.E.P.Q.—Q. 41, Amdt 1*, 1 p. [Washington, D.C., U.S. Dep. Agric.] 1947.

No living larvae of the European corn borer [*Pyrausta nubilalis*, Hb.] having been found in clean, shelled maize entering the United States from Canada during the past 20 years, Amendment no. 1 to regulations supplemental to Quarantine no. 41 [*R.A.E.*, A **15** 192], effective 15th July, 1947, therefore suspends the regulation requiring such maize to be accompanied by a Canadian inspection certificate.

FARSTAD (C. W.) & PLATT (A. W.). **The Reaction of Barley Varieties to Wheat Stem Sawfly Attack.**—*Sci. Agric.* **26** no. 5 pp. 216–224, 11 refs. Ottawa, 1946.

The following is based largely on the authors' summary. In recent years, growers on the open plains of western Canada have been sowing barley early instead of late, as investigations have shown that early sowing results in much larger crops. Since it exposes the crop to attack by *Cephus cinctus*, Nort., a

series of field observations was made on sawfly infestation and damage to early-sown barley in Saskatchewan and Alberta in 1941–43, and experiments on varietal difference in reaction to infestation and damage were carried out in the same Provinces in 1944 and 1945 with barley sown in May. In the field, practically no damage was sustained by the varieties Prospect and Newal when sown early ; the initial infestation in them was sometimes very high if wheat, which was much more attractive to the sawflies, was not available, but many of the larvae died soon after they hatched, and very few survived to mature and cut the stems. Investigation of reports of severe damage to barley showed that in all cases but one, Hannchen was the variety grown, indicating that varietal differences existed. Nine varieties that were sown in replicated single-row plots in various localities showed significant differences in infestation in all localities and significant differences in the percentages of stems cut by the sawfly in all but one. These results were in general agreement with the field observations. The proportion of stems cut varied with the proportion infested for the different varieties ; Trebi was the most resistant, Plush, Prospect and Newal were rather less so, and Hannchen and Rex were the most susceptible to damage. None of the barleys was damaged to the same extent as adjacent plots of Apex, Marquis or Thatcher wheat, and the percentage parasitism of larvae of the sawfly by *Bracon* (*Microbracon*) *cephi*, Gah., was 6–51 in barley as compared with 5 or less in wheat. The amount of damage caused to the varieties of barley differed considerably in different localities, indicating that environmental factors influence it.

It is pointed out that even though the economic damage to susceptible barleys is relatively small, infested barley provides reservoirs of infestation that are a danger to neighbouring wheat. At present the barley sown in the sawfly area is almost exclusively of resistant varieties, and it is suggested that the introduction of susceptible varieties should be avoided.

White (R. M.). **Preliminary Observations on some Effects of artificial Defoliation of Wheat Plants.**—*Sci. Agric.* **26** no. 5 pp. 225–229, 1 fig. Ottawa, 1946.

The following is based on the author's introduction and summary. Grasshoppers are among the most widespread and persistent pests of cereals on the Canadian prairies ; the newly-hatched hoppers quite commonly defoliate the young plants so that the whole field appears bare, and the older hoppers and adults frequently strip the leaves from well-developed plants, leaving the stem and flowering head intact. As the plants sometimes produce new leaves and appear to develop normally if the grasshoppers are destroyed, the effect of defoliation on yield was studied in experiments in which it was simulated artificially. The results showed that defoliation of the wheat plant at any stage in its development did not necessarily result in crop failure. Its yield suffered most when it was defoliated during the period between the heading and dough stages. Its defoliation during the two weeks previous to its maturity was not injurious, as indicated by the yield. Defoliation of the growing plant did not affect the quality of the grain, but did affect the quantity and also the weight per bushel.

Glendenning (R.). **The Carrot Rust Fly. A new Pest in British Columbia.**—*Process Publ. Div. Ent. Dep. Agric. Can.* no. 52, 5 pp., 5 figs. Ottawa, 1946.

Since 1939, considerable damage has been caused to both field and garden carrots in British Columbia by the carrot rust fly [*Psila rosae*, F.] which was first observed in the Province in 1936. There are three generations a year, and the adults appear mainly from the middle of April to late May, from early

July to August and from September until the November frosts. The actual date of emergence in spring depends on the earliness of the season, and summer emergence is delayed by hot, dry weather with temperatures over 80°F. The females lay 10–30 eggs each on the crowns of the plants or in soil close by, and the larvae bore into the roots, causing stunting and forking of young carrots and holes in older ones. The larval and pupal stages each last about a month ; pupation takes place in the soil at a depth of 2–6 inches.

Where the appearance of the flies is regular or can be foreseen, carrots can be protected by sowing them at suitable times, for instance, too late for oviposition by the overwintered generation but early enough to harvest in early July, before adults of the next generation appear. Soils cracked by drought or loosened by hoeing, which are favoured for oviposition, should be avoided, and carrots should be harvested as early as practicable in September and stored only if uninfested. All infested roots should be buried deeply. Of insecticides tested, only naphthalene and mercurous chloride (calomel) were satisfactory ; derris was not effective against heavy infestations, and DDT did not give control. Three applications of 1 lb. crude naphthalene per 100 sq. ft., broadcast over the foliage and ground of the bed at weekly intervals when the flies were present, gave effective control [*cf. R.A.E.*, A **34** 319] and caused no tainting of the carrots. A dust of mercurous chloride and talc (1 : 24 by weight) applied to the crowns of the carrots at the rate of 1 lb. per 200 ft. of row also gave excellent control ; it lasted longer than naphthalene in hot weather, and three applications at weekly intervals in wet weather or two at ten-day intervals if little rain had fallen gave good protection. Treatments should be made when the fly is first seen ; in the coastal areas of British Columbia they will be needed in April–May for early carrots, in July for the main crop and in September for late carrots.

MUNGOMERY (R. W.). **Report of the Division of Entomology and Pathology.**— *46th Rep. Bur. Sug. Exp. Stas Qd 1945–46* pp. 31–38. Brisbane, 1946.

Damage to sugar-cane by *Dermolepida albohirtum*, Waterh., in Queensland during the year ending 30th June 1946 was the heaviest recorded for over 20 years. It was especially severe and widespread in two districts in northern Queensland and was substantially increased by extremely unfavourable growing conditions. Flights occurred in October in areas where early rains fell, but were delayed until December in the drier parts of northern Queensland [*cf. R.A.E.*, A **35** 28, etc.]. The adults did not appear to be unusually abundant, and the heavy attack is attributed to very favourable conditions for the eggs and young larvae. As a result of drought in spring and summer and the abrupt ending of the monsoon rains in March, most canes had made little growth before the roots were severely attacked, and many made no further progress after March ; some of the crops failed completely. In some districts, infestation was so heavy that green manure crops and garden shrubs were also attacked. The infested area in northern Queensland between Tully and Mossman was almost 13,000 acres in extent, and losses amounted to about 105,000 tons of cane ; farther south, in the Burdekin and Mackay districts, damage was neither extensive nor severe and the estimated loss in the latter area was only 300 tons. Control by soil fumigation with carbon bisulphide was only partly successful owing, generally, to unfavourable soil conditions. Cyclones in February and March caused much lodging, and mechanical injectors could therefore be used only on backward crops in districts where the beetle flight was early ; where the flight was late, it fell too near the end of the wet season to allow much fumigation before the soil dried out. As cyclones are common during the normal fumigation season, it would be advantageous to fumigate earlier, but the larvae are not as a rule concentrated then near the cane but are dispersed

irregularly throughout the soil. Applying the fumigant simultaneously down the centre and along the edges of the space between the rows to overcome this difficulty gave a high degree of control and was the most effective method employed at the North Experimental Sugar Farm ; fumigation by the normal methods applied at the same time did not give practical control. Other advantages of early fumigation are that the equipment can easily pass between the rows when the canes are small, the treatment is applied before serious damage has been inflicted, and the cane can benefit from good growing conditions over a longer period. Sprays containing 0·2 per cent. p,p′ DDT or enough benzene hexachloride to give 0·2 per cent. γ isomer, applied to the foliage of trees on which the beetles feed, were as effective as one containing 0·4 per cent. lead arsenate, and a spray containing 1 per cent. p,p′ DDT produced a more rapid mortality. Benzene hexachloride applied to the soil was highly toxic to the beetles, and gave rapid mortality at a concentration of 1 part γ isomer in two million parts soil. A dust containing 1·3 per cent. γ isomer, applied about seven weeks before beetle flight (late December 1945) at rates of 100 and 400 lb. per acre to the soil in the furrows of a plant crop and in drills on either side of the rows of a ratoon crop, in both of which heavy infestations were expected, gave 85 per cent. mortality of first instar larvae and practically complete mortality by the time the late second instar was reached, the two rates of application being equally effective. In the following May, the plants that had received this treatment were green and vigorous, whereas the untreated controls were yellow and stunted. Dusts of DDT applied in a similar manner gave very poor results. Soil treated with benzene hexachloride remained toxic to the young larvae for several months, which is an advantage in view of the long period over which the adults emerge and oviposit.

Damage to cane by larvae of *Lepidiota frenchi*, Blkb., was also severe as a result of the dry season. Large areas on the drier hill slopes were attacked, and in some cases the canes made so little progress that they were ploughed under before the end of the year. Injury by this species and by *D. albohirtum* was intensified by the general deterioration in soil fertility. In part of the Mackay district, *L. frenchi* caused the loss of some ratoon crops, and elsewhere it was sufficiently abundant to retard growth even under conditions favourable to the plants ; throughout the district, tonnage losses due to it were at least double those due to *D. albohirtum*. Larvae of *L. trichosterna*, Lea, were more injurious than usual in the Bundaberg area of southern Queensland, but were in general successfully controlled by fumigation with carbon bisulphide. Larvae of *Pseudoholophylla furfuracea*, Burm., were injurious on red volcanic soils in three southern districts, and the damage was aggravated by the drought.

Rhabdoscelus obscurus, Boisd., continued to be under almost complete control [*cf.* **34** 1 ; **35** 29], partly as a result of the widespread adoption of pre-harvest burning during the war years, but also owing to the reduced incidence of top-rot [*Phytomonas rubrilineans*], the production of lighter crops owing to inadequate supplies of fertilisers, and the increased use of resistant varieties. The wireworm, *Lacon variabilis*, Cand., was not abundant in 1945, but caused serious damage in some plantings early in 1946 ; benzene hexachloride gave promising results in preliminary trials in which it was applied to the soil for the protection of setts.

A few swarms of *Gastrimargus musicus*, F., appeared in parts of the Mackay and Lower Burdekin districts, where a few isolated egg beds still persisted at the end of the season, but damage to sugar-cane was in general negligible. Some swarms invaded and oviposited in the Gordonvale area in March 1946, and several small bands of hoppers subsequently appeared. Bran baits containing benzene hexachloride were highly effective against the latter except when applied during ecdysis, and a spray containing 0·2 per cent. γ isomer was very effective against hoppers congregated together in the late afternoon ; others that later entered and fed on the sprayed grass were also killed.

A widespread outbreak of larvae of *Mocis trifasciata*, Steph., *Cirphis unipuncta*, Haw., and *C. loreyi*, Dup., occurred on low ground bordering the Mulgrave river following the floods in March 1946, but only the first species was sufficiently numerous to cause much damage. Outbreaks of this Geometrid, which is not as a rule abundant in cane fields, appear to occur about every ten years. In 1946, it completely defoliated cane over many acres. Several Dipterous parasites were reared from the larvae and two Ichneumonids from the pupae.

Studies on the transmission of the Fiji disease of sugar-cane [*Galla fijiensis* of Holmes] by *Perkinsiella saccharicida*, Kirk., indicated that nymphs transferred from diseased plants to healthy ones can transmit the virus after feeding on the latter for 20 hours and that they remain infective for at least 16 days. A test in which they were allowed to feed on different parts of young, healthy plants showed that transmission can take place through the young spindle, the mature leaves and the leaf sheath. The periods required for symptoms of the disease to appear after infective nymphs were caged on the plants ranged from 29 days on well-grown plants to 236 days on stunted ones. This difference is attributed to the more favourable conditions provided by the former for the feeding and reproduction of the Delphacids and the development of the disease.

Sloan (W. J. S.). **Passion Fruit Mite.**—*Qd agric. J.* **63** pt. 3 pt. 145–147, 3 figs. Brisbane, 1946.

Tenuipalpus californicus, Banks, which has been known in Queensland for some years [*cf. R.A.E.*, A **29** 465], attacks a number of plants, including *Citrus*, tomato, choko [*Sechium edule*] and sweet potato [*cf.* also **30** 156; **35** 132], but is an important pest there only on passion vines [*Passiflora edulis*]. The general appearance of infested vines suggests that they are suffering from lack of soil moisture; the older leaves turn yellow prematurely and fall, and the injured surface of the canes becomes covered with a reddish corky layer. Heavy and prolonged attacks may cause the shedding of most of the leaves; buds in the axils of affected leaves may fail to develop or produce only stunted growth, the less sturdy laterals sometimes die back to the main cane, and the entire plant may be killed if the infestation coincides with a prolonged unfavourable growing period. Injury to the fruit, which occurs only in heavy infestations, spreads over the surface from the stalk end, and the rind is disfigured by water soaked areas, which later dry into discoloured patches. Vines that are heavily infested in summer and early autumn make a partial recovery during the winter, and growth may proceed normally until infestation again becomes severe during the following summer. The mites are most likely to be found in the leaf axils, along the grooves in the canes and leaf stalks, and along the main veins of the leaves, immediately in front of the bare section of affected cane.

Successful control has been obtained by spraying with lime-sulphur (1 : 25 to 1 : 40) the weaker solutions being used in hot weather. Dusts of ground sulphur and hydrated lime (1 : 1) check the mites but do not adhere well to the plants; they should be applied when the plants are wet with dew or rain and repeated if removed by rain within 48 hours. Treatment may be required at monthly intervals from September to February. Growers claim to have obtained effective control with a white-oil spray emulsion. Wettable sulphur for control of the mite can be added to fungicidal copper sprays.

Hogan (T. W.) & Stephens (R. M.). **Codling Moth Control. D.D.T. Trials in Victoria.**—*J. Dep. Agric. Vict.* **44** pt. 9 pp. 423–426. Melbourne, 1946.

In field trials carried out in three districts of Victoria during the season of 1945–46, DDT proved much more effective than lead arsenate for control of the codling moth [*Cydia pomonella*, L.] on apple and pear. The DDT sprays used were prepared from a proprietary concentrate containing 20 per

cent. DDT with a petroleum solvent and a miscible-type concentrate containing 15 per cent. DDT and coal-tar solvent naphtha, usually diluted to contain 0·1 per cent. DDT (95 per cent. p,p′ isomer), and lead arsenate was used at 5 lb. per 80 gals. water, alone or with ½ gal. white oil. A calyx spray and four or five cover sprays were applied, according to the normal lead-arsenate schedule based on bait catches. In all the main tests, 0·1 per cent. DDT gave about 99 per cent. undamaged fruit, and the difference between it and lead arsenate was highly significant; the difference between the two DDT sprays was not significant except on one plot on which the solvent-naphtha emulsion was the better. Spraying the trunks of some of the trees with DDT to kill larvae seeking sites for pupation did not significantly affect the percentage of infested fruit or prevent larvae from overwintering in the bark round the butts.

There was some evidence that DDT favoured infestations of *Bryobia praetiosa*, Koch, and *Tetranychus telarius*, L. (*urticae*, Koch), which developed late in the season on both pears and apples; they were not serious, but the effect of treatment over successive seasons might be more marked. The foliage on trees sprayed with DDT was lighter in colour than on those sprayed with lead arsenate, and leaf-fall occurred later. The DDT residues left on the fruits, which ranged from 0·7 to 37 p.p.m., tended to be higher for the proprietary material. When the solvent-naphtha spray was used at double strength, small dark brown spots appeared round the lenticels of the fruit in some cases; these were apparently due to the solvent.

Pasfield (G.) & Holbeche (J.). **Codling Moth Control. Experiments using D.D.T., " 666," and Lead Arsenate at Orange.**—*Agric. Gaz. N.S.W.* **57** pt. 9 pp. 488–491, 498. Sydney, 1946.

Pasfield (G.) & Bryden (J. D.). **Codling Moth Control. Experiments at Bathurst using D.D.T., " 666 " and Lead Arsenate.**—*T.c.* pt. 10 pp. 535–538.

The experiments described in these papers were carried out at two places in New South Wales in the season of 1945–46 to compare the efficiency of DDT, 666 (benzene hexachloride) and lead arsenate in sprays against *Cydia pomonella*, L., on apple, and to determine the effects of the organic insecticides on other apple pests. The sprays comprised 0·1 per cent. DDT (95 per cent. p,p′ isomer) prepared by diluting a solution in solvent naphtha with an emulsifier, 0·1 per cent. 666 (13 per cent. γ isomer) prepared by diluting an emulsion of the mayonnaise type containing it, or lead arsenate at 3–4 lb. per 100 gals. of water with ½–1 lb. calcium caseinate as spreader and sometimes with lime-sulphur. The experimental trees at Orange comprised the varieties Jonathan and Granny Smith, and those at Bathurst Granny Smith only, and these two varieties received six and seven cover sprays, respectively, in addition to a calyx spray. The lead arsenate schedule was varied at Orange by the addition of 1 gal. white oil to the third and fifth cover sprays; and at Bathurst, 1 pint nicotine sulphate was added to the first, fourth and sixth cover sprays and 1 gal. white oil to the second. DDT gave outstanding control in both localities, but 666 was inferior and trees receiving it at Orange were so heavily infested after the fourth cover spray that lead arsenate was substituted for the remaining applications. The average percentages of infested fruits, including windfalls, for Jonathan and Granny Smith, respectively, at Orange, were 1·2 and 2·7 for DDT, 11·4 and 16·3 for lead arsenate and 49·4 and 59·6 for 666 followed by lead arsenate; the figures at Bathurst were 14·8 for DDT, 36·6 for lead arsenate and 84 for 666. The differences between treatments were significant in both districts. Over 80–90 per cent. of the infested fruits from the plots sprayed with 666 had been entered through the calyx, indicating a lack of residual effect in the 666 calyx spray. The

DDT spray spread much better than the others ; deposits of a yellow, greasy, amorphous material were found in the spray vat after spraying with 666.

All trees sprayed with DDT became heavily infested by *Bryobia praetiosa*, Koch, which was controlled by a spray of wettable sulphur at Orange, but no infestation was observed on those sprayed with lead arsenate or 666. Isolated colonies of *Eriosoma lanigerum*, Hsm., appeared on some trees sprayed with DDT at Bathurst, but there was no abnormal increase in infestation. Varying degrees of sunscald were observed on some Jonathan apples that had been sprayed with DDT, whereas such injury was negligible on the others. At Bathurst, there was a relatively large increase in the percentage infestation on low-yielding trees sprayed with DDT, but the increase at Orange was negligible. The average DDT residues did not exceed 11 parts per million on any of the fruits.

The results of a small laboratory experiment at Bathurst, in which batches of ten mature larvae of *C. pomonella* all survived confinement for 1 or 4 hours on filter papers that had been dipped for two minutes in emulsions of the mayonnaise type containing up to 2 per cent. DDT and allowed to dry, did not indicate that DDT would have any value as a trunk spray against hibernating larvae [*cf.* preceding abstract].

Hely (P. C.). **Control of *Thrips tabaci* on Onions. Experiments with D.D.T. and Tartar Emetic.**—*Agric. Gaz. N.S.W.* **57** pt. 9 pp. 467–471, 3 refs. Sydney, 1946.

An account is given of an experiment carried out in New South Wales in 1945–46 on the control of *Thrips tabaci*, Lind., on onion, in which the insecticides used were a spray containing an emulsified solution of DDT in solvent naphtha, diluted to give 0·1 per cent. DDT and applied directly over the plants at about 96 gals. per acre, a dust of 1 per cent. DDT in pyrophyllite, applied at about 32 lb. per acre, and a bait-spray of 1 oz. tartar emetic and 4 oz. sugar per 4 gals. water [*cf. R.A.E.*, A **31** 262], applied as a fine mist at about 48 gals. per acre. Seedlings of both white and brown varieties of onion, some of which had been dipped in the DDT spray, were planted out on 2nd August and treatments were applied to all varieties on 3rd, 12th, 19th and 29th October and 12th November and to the brown ones also on 27th November. In early November, after four applications, the plants sprayed with DDT were about twice as tall as the untreated controls and were almost completely free from mottling or buckling of the leaves, whereas the controls were stunted and mottled and the leaves withered and distorted. The dusted plants were intermediate in height and appearance, while those sprayed with tartar emetic were superior to the controls but inferior to the dusted plants. Counts on inner leaves of the brown onions, made on 23rd November, showed average populations of 1·9, 27·8, 37·6 and 40·5 thrips per leaf for the three treatments and the controls, respectively. The few thrips on the plants sprayed with DDT were all adults, whereas large numbers of nymphs were present on the others.

White onions were harvested on 27th November and brown ones on 18th January, and the bulbs weighed. All treatments increased the yield, but the DDT spray was outstanding. As compared with the dust, the tartar emetic and no treatment, respectively, it increased the yield of brown onions by 40·6, 68·3 and 75 per cent., and that of white onions by 11·1, 12·9 and 26·8 per cent. The differences between spraying and dusting were significant for the brown onions but not for the white ones, probably because the latter were pulled before they were full-grown. Dipping the seedlings prior to planting appeared to be of value and gave a significant improvement in the yield of white onions. It is shown from these results that spraying with DDT increased the financial return per acre by £28 3s. 6d. for white onions and £80 1s. 0d. for brown ones, when allowance was made for the cost of the spray but not the cost of applying it.

Insect Pests.—*Agric. Gaz. N.S.W.* **57** pt. 9 pp. 480–482, 3 figs., 1 ref. Sydney, 1946.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **35** 191] contains notes on the habits and control of ants. Those that invade dwellings and feed on foodstuffs include the small black ants, *Technomyrmex detorquens*, Wlk. (*albipes*, F. Sm.), *Tapinoma* sp. and *Iridomyrmex* sp., the small brown ants, *Monomorium pharaonis*, L., and *Pheidole megacephala*, F., and, less often, the sugar ant, *Camponotus nigriceps*, F. Sm. They can all be controlled by baits; the one recommended against the small black ant and *Camponotus* is prepared by stirring 1 fl. oz. 5 per cent. solution of sodium arsenite (80 per cent. arsenious oxide) into 1 lb. honey [*cf.* **28** 98]. A small teaspoonful of this bait or the amount adhering to six wooden matches dipped into it is the quantity to offer any colony at one time. An alternative bait, which can be offered in tins with holes in the sides, has already been noticed [**22** 622]. A third, which is readily taken, not only by these species, but also by the small brown ants, is prepared by heating 1 lb. sugar and 27 grains thallium sulphate in 1 pint water, and adding 3 oz. honey.

The mound or meat ant, *Iridomyrmex detectus*, F. Sm., which forms large nests in or near gravel paths or on tennis courts, and the bulldog or soldier ants of the genus *Myrmecia*, notably *M. gulosa*, F., which often nest near houses and have painful stings, can be controlled by fumigating the nests [*cf.* **22** 622]. Lawns and golf greens in northern coastal areas are damaged by a brown ant, *Aphaenogaster pythia*, Forel, which raises small craters of earth round the entrances to its nests.

Reference is made to recent tests with DDT against some of these ants [**35** 161].

McCarthy (T.). **Control of Grasshoppers. Use of Sawdust in Poison Bran Bait.**—*Agric. Gaz. N.S.W.* **57** pt. 10 p. 506. Sydney, 1946.

In view of the shortage of bran in New South Wales, the author recommends that sodium arsenite baits for the control of grasshoppers should be made up with a mixture of bran and sawdust in place of bran alone. Such a bait has not been used in field campaigns, but a mixture of equal parts of sawdust and bran was as effective in experiments in 1937 as bran alone; a bait in which the bran was entirely replaced by sawdust gave little mortality. Mixtures containing various proportions of sawdust and bran are widely used in the United States [*cf. R.A.E.*, A **29** 144], but the bran employed there differs from that in use in New South Wales. It contains a large proportion of pollard and on the addition of the water and sodium arsenite is reported to form a poisoned paste, which coats the particles of sawdust. The grasshoppers eat the paste, but not the underlying sawdust. Old, weathered sawdust, preferably coarse and granular in texture, is the best for this purpose. The author suggests that the sawdust and bran should be mixed in equal parts by volume and states that the chief disadvantage to the use of sawdust is that it would have to be transported for a considerable distance in some cases. It would also have to be sieved to remove chips and other débris.

Wason (E. J.). **D.D.T. as a Control of Caterpillars attacking Peaches.**—*Agric. Gaz. N.S.W.* **57** pt. 10 p. 520. Sydney, 1946.

During late October and early November 1945, larvae of *Heliothis armigera*, Hb., which have of recent years been injurious to peaches, apricots and to a less extent, pome fruits in the Murrumbidgee Irrigation area of New South Wales, were found to be damaging young developing peaches on several farms in the Leeton district, having migrated from bur clover [*Medicago hispida*]

growing in the orchards. On 2nd November, a spray containing 0·1 per cent. DDT as an emulsified solution in solvent naphtha was applied to the lower third of some of the infested trees, where the larvae, most of them almost full-fed, were concentrated. About five minutes after spraying, all the larvae had fallen to the ground and were unable to crawl. Some that were placed in jars with fresh lucerne were all dead within 17 hours. The larvae were still numerous and active on the unsprayed trees on 5th November, but none was observed on the sprayed trees and there were many dead ones among the litter surrounding them, together with Chrysopids, blowflies and a few adult Coccinellids. The same spray diluted to contain 0·05 per cent. DDT was applied on 5th November and produced a similar result, and no ill-effects were observed on the developing fruits or foliage on any of the sprayed trees.

WASON (E. J.). **The Inland Green Tree-hopper (*Caedicia simplex* Walk.), an important Pest of canning Peaches.**—*Agric. Gaz. N.S.W.* **57** pt. 10 pp. 521–524, 3 figs., 1 ref. Sydney, 1946.

An account is given of the bionomics of *Caedicia simplex*, Wlk., which is injurious to *Citrus* and stone fruits in the Murrumbidgee Irrigation area of New South Wales [*cf. R.A.E.*, A **34** 208]. The injury consists of holes of various sizes caused by the Tettigoniids gnawing into the flesh of the fruits; on peach and nectarine, most of the surface of the fruits may be damaged, whereas on *Citrus*, the injury mostly occurs soon after the fruit has set and appears on the ripe fruits as sunken, silver-coloured patches. Considerable losses of peaches grown for canning may be caused by a light infestation, since one individual feeds on several and injured fruits can only be used as sliced peaches or for jam-making. The amount of injury varies in different orchards and on different trees, and counts have shown that up to 22 per cent. of the fruits may be affected.

Control on peaches can be obtained by a spray of 1 lb. barium fluosilicate (containing at least 80 per cent. active ingredients) in 40 gals. water, applied early in the season while the young nymphs are feeding on the foliage and before the fruit becomes attractive enough to be attacked. The spray should be applied as a mist, and, where the nymphs are ascending the trees, it is often sufficient to spray only the sucker growth and the lower half of the trees. If spraying is not completed during late October, however, the whole of the trees should be sprayed before mid-November. On *Citrus*, the spray should be applied soon after fruit-setting, usually about mid-October. A spray of 1 lb. lead arsenate in 40 gals. water, with 5 lb. hydrated lime as a safener can also be used on peach and nectarine, but some other insecticide should be used on *Citrus* [*cf. loc. cit.*]; zinc sulphate (alone or in combination with hydrated lime), ferrous oxide or aluminium oxide can also be used as safeners. A 50 per cent. lead arsenate dust has proved satisfactory in experiments, but calm conditions are essential for its application. Limited tests with 0·1 per cent. DDT, both as an emulsified solution and as a suspension, have given promising results against Tettigoniids infesting canning peaches.

WALLACE (C. R.). **Combatting the Black Beetle in Maize. Soil Jetting Experiments with D.D.T. and "666."**—*Agric. Gaz. N.S.W.* **57** pt. 10 pp. 543–545, 550, 1 ref. Sydney, 1946.

Details are given of experiments in New South Wales in February–May 1946 on the protection of maize from adults of *Heteronychus sanctae-helenae*, Blanch., by jetting the soil with sprays of 666 (benzene hexachloride) and DDT. The main results have been noticed from a summary [*R.A.E.*, A **35** 218], but it is now stated that the DDT spray was an emulsified solution in solvent naphtha containing 0·1 per cent. p,p′ DDT, and that the benzene hexachloride

was used as an emulsified solution in xylene. In the test in which benzene hexachloride was applied first to the maize seed and then to the soil along the rows, the second application, which was shown to be necessary for adequate control, was made a week after the first, when the plants had appeared above ground. The concentrations of the ingredients in the first treatment, as in the treatment of the maize rows only, were 0·12 per cent. w/v benzene hexachloride (total isomers), 0·05 per cent. γ isomer, 0·48 per cent. v/v xylene and 0·05 per cent. emulsifier, but they were increased in the second treatment to 0·35, 0·09, 2·8 and 1·54 per cent. respectively. The first emulsion caused no injury to the maize, but the second caused severe leaf scorch in the young plants and some retardation of their growth rate.

SONTAKAY (K. R.). **The Bark-eating Borer of Orange.**—*Indian Fmg* **6** no. 2 pp. 74–75, 1 pl. Delhi, 1945.

Indarbela quadrinotata, Wlk., is one of the most injurious pests of *Citrus* in the Central Provinces and Berar; the larvae feed on the bark, damaging the sap-conducting tissues and so reducing the yield and quality of the fruit. Older trees are usually more heavily infested, but trees of all ages are attacked; there may be as many as 15–20 larvae per tree. The eggs are laid on the bark in May–June in groups, usually of 15–25, and hatch in 8–11 days. The larvae web shelters of wood, silk and excreta and live under them, feeding superficially on the bark until September. They then bore into the bark and underlying tissues in the angles of branches, or enter holes made by larvae of previous generations, and feed in these during the day and spend the night in their shelters. They become full-grown in December. They pupate in late April in the tunnels, and the pupal stage lasts 21–31 days, the moths emerging from the second week of May to the first week of June and living for only a short time. There is one generation in the year. Other food-plants include mango, pomegranate, guava and mulberry.

The larvae should be controlled by locating their shelters in September or October, before much damage has been done, putting a wad of cotton-wool dipped in a fumigant such as carbon bisulphide into the tunnels near them and closing the entrances with clay.

RAHMAN (K. A.) & YUNUS (M.). **The Citrus Leaf Miner.**—*Indian Fmg* **6** no. 5 p. 221. Delhi, 1945.

The citrus leaf miner [*Phyllocnistis citrella*, Staint.] causes much injury to *Citrus* in the Punjab, where it can be found in tender shoots and leaves in most plantations. The egg, larval and pupal stages last 2–10, 5–30 and 5–25 days, respectively, and populations are smallest in December–February and largest in March–May and September–November. Pruning the plants and picking off infested leaves during December and January, when the early stages predominate, reduces infestation considerably if the prunings and leaves are burnt or buried. During April–May or September–October, the plants should be sprayed three times at intervals of 10–14 days with nicotine sulphate and fish-oil soap (1 : 8 : 800) or with a tobacco decoction and soap [*cf. R.A.E.*, A **21** 502], directions for preparing which are given.

HAROON KHAN (M.). **Driving Hopper-bands of Desert Locust to the Trenches.**—*Indian Fmg* **6** no. 7 pp. 296–299, 1 fig., 3 refs. Delhi, 1945.

The desert locust [*Schistocerca gregaria*, Forsk.] breeds permanently in India in desert and semi-desert areas extending over about 500,000 square miles, and since control is carried out there largely by untrained labour, the hoppers can most effectively be destroyed by means of trenches. These were

extensively used during the outbreak of 1941–44, and in this paper the author discusses the most effective method of organising the work, based on the experience gained.

Trenches are best dug on level ground with sparse or no vegetation, about 30 ft. in front of a band of hoppers. Among sand dunes, they were effective when dug on the top, in front or on the further side of a dune, but not in front of ascending bands. The work was carried out by gangs of 15–20 men, of whom 5–6 dug the trenches and all assisted in driving the hoppers up to them. As it is important that the trenches be made quickly, they should not be too long. One gang could easily drive a band occupying an area of 150 sq. ft. into a trench 30 ft. long, and larger bands were either divided into several portions, each of which was dealt with separately, or were driven undivided into longer trenches dug by several parties combined. Pits 5-6 ft. deep should be dug in the trenches to prevent the hoppers from escaping ; one at each end and one in the middle are sufficient in trenches 30–40 ft. in length, but in longer ones they should be dug every 7–10 ft. Trenches 30 ft. long could be dug in half an hour where the soil was light and sandy, and the sides were easily made smooth with a spade or by hand. In some cases, trenches were used more than once, and it was then necessary to smooth the sides on each occasion, since exposure to sun and wind for a few hours caused cracks through which the hoppers could escape. Straight trenches are preferred to V-shaped ones, since their construction requires less time and labour. Driving should not be begun until the trench is completed. The men should be evenly distributed round the band of hoppers, except on the side nearest to the trench and, if the hoppers are very numerous, the one from which they are coming ; no one should cross the encircled area, since this is likely to cause the hoppers to change their direction. The men farthest from the trench should move forward at the same speed as the hoppers and make some noise in doing so, but those at the sides should move slowly and quietly. Hoppers attempting to escape through the sides of the circle can be prevented if the men nearest to them move sideways, preferably waving a branch. If hoppers attempt to escape at defective points in the far side of the trench, one or two men should leave the circle and sit opposite the defective point at a distance of 8–12 ft. from it, when the hoppers soon cease to move. Great difficulty was experienced when large numbers of hoppers collected on bushes, and as many of the latter as possible should be removed from the area. The men behind bushes in which hoppers have collected should not proceed further and men from the sides should not pass in front of the bushes. The hoppers generally move in the direction of the wind and can be dislodged by throwing sand at the bushes from behind and subsequently cutting a few branches. If the bushes are too thick for this, the hoppers can be smoked out by burning piles of half-dry grass. Towards the end of the driving operation, two or three men may leave the circle and begin scouting for other bands.

RAKSHPAL (R.). *Citrus* **Fruit Sucking Moths and their Control.**—*Indian Fmg* **6** no. 10 pp. 441–443. Delhi, 1945.

Considerable damage has recently been caused to ripening fruits of *Citrus*, other than lemon, in Gwalior State by the fruit-piercing moths, *Othreis* (*Ophideres*) *materna*, L., *O.* (*O.*) *fullonia*, Cl. (*fullonica*, L.), *O.* (*O.*) *ancilla*, Cram., and *Achaea janata*, L., of which the first two are the commonest [*cf. R.A.E.*, A **33** 386, 391 ; **34** 281]. The species of *Othreis* attack at sunset and *Achaea* after midnight, and there is no difference in damage on dark or moonlight nights. Juice exudes from the puncture, and is fed upon by various secondary insect pests, and rot sets in in a circular area round it ; injured fruits tend to ripen prematurely and invariably fall within a week, though fruits pierced with a thorn ceased to exude juice within five minutes and showed

no difference in development from undamaged ones. Green fruits are attacked in the absence of ripe ones. Both *O. materna* and *O. fullonia* breed on Menispermaceous creepers such as species of *Tinospora* and *Anamirta* and the egg, larval and pupal stages last 3–4, and about 15 and 21 days, respectively. The moths are strong fliers and occur in inland orchards far from any known areas in which their food-plants grow. They normally shelter during the day in bushes near the orchards.

Citrus flowers in Gwalior in January, June and September, and the fruits mature 8–10 months later. Since the moths are active only in the rainy season, from the first week of July to the last week of September, it is suggested that the flowers that appear in June and September should be allowed to develop into fruit, and that those appearing in January, which would give rise to fruit during the rainy season, should be suppressed by withholding water and exposing the roots of the trees for a time. This was tried by growers, and a heavy crop was subsequently obtained.

Wolcott (G. N.). **Factors in the natural Resistance of Woods to Termite Attack.**—*Caribb. Forester* **7** no. 2 pp. 121–134, 12 refs. Rio Piedras, P.R., 1946. (Also in Spanish, pp. 139–149, with a Summary in French.)

The following is based largely on the author's summary. Laboratory tests with *Kalotermes* (*Cryptotermes*) *brevis*, Wlk., in Porto Rico and field observations indicate that some kinds of wood are much more acceptable to termites than others and that a few are very resistant to attack or practically immune [*cf. R.A.E.*, A **29** 157]. Of the major constituents of wood, cellulose is readily digested by the enzymes of protozoa living in the digestive tract of termites, whereas lignin is entirely indigestible, so that woods with a high cellulose content have a high food value for termites, whereas those with a high lignin content are invariably avoided. In the case of all timbers tested, the sapwood, which contains starch and sugars, was more attractive than the heartwood, which contains more lignin in many tropical hardwoods. Wood also contains other specific constituents, some of which may be decisive in determining whether the wood can be eaten by termites. Tests of the tannin quebracho (a polymer of 7,3,4-trihydroxyflavanol from the heartwood of *Quebrachia lorentzii*) and of common vegetable dyes such as hematoxylin (from the heartwood of *Haematoxylon campechianum*), fustic (from *Chlorophora tinctoria*) and morin (a pentahydroxyflavone), applied to wood, indicated that they have little deterrent effect. The resistance to termites of West Indian mahogany, *Swietenia* [*mahagoni*] is due more to its high lignin content than to the presence of catechin. Saponin and the alkaloid brucine can prevent termite attack only if present in large amounts. Anacardic acid oxidises in three months, and guaiacol and linalool volatilise too rapidly to stop termites if they are applied merely superficially. The most effective of the quinones tested were tectoquinone (β-methylanthraquinone), which is present in East Indian teak, *Tectona grandis* (50·1 per cent. lignin) in amounts large enough to account for its resistance to termites, and alizarin (1,2-hydroxyanthraquinone) of the madder plant [*Rubia*].

The wood of many tropical trees and a few semi-tropical ones, but of none but osage orange (*Maclura* (*Toxylon*) *pomifera*) and southern cypress [*Taxodium distichum*] from the temperate zone, is resistant to or immune from the attack of *K. brevis*. Such natural resistance as coniferous woods of the temperate zone possess is due to their natural impregnation with specific resinous gums. Pine oil and its bulkier constituents volatilise rapidly, but the chlorination of terpenes greatly increases their toxicity to termites and the duration of their effectiveness.

Phillips (V. T.). **The Biology and Identification of Trypetid Larvae (Diptera : Trypetidae).**—*Mem. Amer. ent. Soc.* no. 12, [2 +]161 pp., 16 pls., 3 figs., 6½ pp. refs. Philadelphia, Pa., 1946.

The author gives a general description of the structure of Trypetid larvae and the method of preparing larval skins for study, a key to the 45 species dealt with in this paper, descriptions of the larval stages of these, and some information on their habitats, the plants they attack and the damage they cause. They include some present in the United States and others that may be introduced. The paper also includes alphabetical lists of 442 species of Trypetids of which the food-plants are known and of the food-plants, an index to all the species of flies and a glossary of some of the terms used. The names employed for the insects are based not on priority but on usage.

Hambleton (E. J.). **Studies of hypogeic Mealybugs.**—*Rev. Ent.* **17** fasc. 1–2 pp. 1–77, 77 figs., 3 refs. Rio de Janeiro, 1946.

This paper comprises a revision of the mealybugs of the genera *Rhizoecus*, *Ripersiella*, *Geococcus*, *Radiococcus*, *Brevicoccus*, *Morrisoniella* and *Neorhizoecus*, of which the last four are new. Together with *Pseudorhizoecus* they represent a natural group, within the Pseudococcinae, the members of which inhabit the soil and feed on the roots of plants. They are found in all the zoögeographical regions of the world, in all kinds of soil and at all altitudes, but appear to be most abundant in the neotropical region and are often associated with ants [*cf. R.A.E.*, A **33** 147]. The morphological characters of the group are discussed, keys are given to the seven genera and the 53 species, of which 27 are new, and the genera and species are described, with notes on food-plants and geographical distribution. The new species associated with economic plants are *Morrisoniella americana* on coffee, and *M. theobromae* on cacao, both in Ecuador, *Neorhizoecus andensis* on coffee in Colombia, and *Morrisoniella globocula* and *Ripersiella ornata*, both on coffee and cacao in Trinidad. Of species already mentioned in this review, *Rhizoecus cynodontis*, Green, *R. dianthi*, Green, and *R. elongatus*, Green, are transferred to the genus *Morrisoniella* ; *R. coffeae*, Laing, to *Neorhizoecus*, of which it is the genotype ; and *R. albus*, James, and *R. amorphophalli*, Betrem, to *Ripersiella*. *Rhizoecus terrestris*, Newst., and *R. decoratus*, Green, are considered synonyms of *R. falcifer*, Künck.

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White (W. H.) & Doolittle (S. P.). **A Vegetable Gardener's Handbook on Insects and Diseases.**—*Misc. Publ. U.S. Dep. Agric.* no. 605, 30 pp., 67 figs. Washington D.C., 1946. [Revision of a previous handbook: *R.A.E.*, A **32** 420.]

Cottam (C.) & Higgins (E.). **DDT : its Effect on Fish and Wildlife.**—*Circ. Fish Wildlife Serv.* no. 11, 14 pp., 13 refs. Washington, D.C., 1946. [*Cf. R.A.E.*, A **35** 177].

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The Institute will be greatly indebted to readers who may be able to supply any of the following, which should be sent to the Director, Imperial Institute of Entomology, 41, Queen's Gate, London, S.W.7.

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